LOS OSOS COMMUNITY SERVICES DISTRICT
WASTEWATER FACILITIES PROJECT

DRAFT PROJECT REPORT

REGISTERED PROFESSIONAL ENGINEER
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No. 16287
Exp 6/30/01
CIVIL
STATE OF CALIFORNIA

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CONTENTS

"The Federal Clean Water Act provides for the creation of a State Revolving Fund (SRF) Loan Program capitalized in part by Federal funds. The Federal Clean Water Act (CWA) authorizes loan funding for construction of wastewater treatment and for water recycling facilities, for implementation of nonpoint source and storm drainage pollution control management programs, and for the development and implementation of estuary conservation and management programs. The Policy for Implementing the State Revolving Fund for construction of Wastewater Treatment Facilities (SRF Policy) only addresses the issuance of loans for wastewater treatment and water recycling facilities. The priority system, however, covers all eligible SRF activities. The SRF is intended to provide loans in perpetuity for construction of wastewater treatment and water recycling facilities, and for implementation of nonpoint source, storm drainage, and estuary conservation projects using State of California (State) and Federal funds (SWRCB, 1998)."

The fifth amendment of the SRF Policy was originally adopted by the State Water Resources Control Board (SWRCB) on August 18, 1988. This Draft Project Report is guided by the requirements contained in the amended SRF Policy, (SWRCB, 1998) which first applied to projects receiving Facilities Plan Approval from the Division of Clean Water Programs after June 18, 1998.

"The primary purpose of the SRF Loan Program is to implement the CWA and various State laws including the Clean Water Bond Law of 1984, the Safe, Clean Reliable Water Supply Act (1996 Bond Law), and any subsequent bond laws, by assisting in the financing of wastewater treatment facilities necessary to prevent water pollution, recycle water, correct nonpoint source and storm drainage pollution problems, and provide for estuary enhancement, and thereby protect and promote the health, safety, and welfare of the inhabitants of the State (SWRCB, 1998)."

This Draft Project Report has been prepared in accordance with Regional Water Quality Control Board, Central Coast Region Basin Plan, Resolution No. 83-13, and Cease and Desist Order Numbers 99-53, 99-54, 99-55, and 99-56. The Draft Project Report was prepared for the Los Osos

Community Services District by Oswald Engineering Associates, Inc. It describes the wastewater facilities that have been selected as a result of the initial planning phase of the Los Osos Wastewater Project. The Draft Project Plan incorporates the first six months of wastewater facilities planning. Further development and refinement of the Draft Project Report will be ongoing over the next six months During this period additional geotechnical and hydrogeological investigations of the Resource Park, the Broderson site, the Morro Palisades site, and the Highland Avenue public right-of-way will be completed. The environmental documentation is underway and builds upon the environmental work done by the County during previous wastewater projects, in particular the method and location of wastewater disposal and the mitigation required for collection, treatment and disposal facilities. Also over the next several months, the finance plan will be completed with the assistance of Bond Counsel, Financial Consultant, and Assessment District Engineer. With these additional inputs, the Project Report will be completed and submitted to the State Water Resources Control Board by September 1, 2000.

We at Oswald Engineering Associates, Inc. are indebted to many persons and agencies for their input and assistance with many parts of this Draft Project Report. First, we are indebted to community of Los Osos, who established by popular election the Los Osos Community Services District, for the opportunity to provide wastewater facilities planning services, for their interest in the AIWPS® Technology, for their independence and self reliance, and for their vision and tireless pursuit of a sustainable solution to the challenges and opportunities of water and wastewater management in their own backyards. We are especially indebted to Gary Karner and Pandora Nash-Karner, Rosemary Bowker, Dr. Les Bowker, and, Wade Brim, Frank Freiler, Jerry Gregory, Geof Gurley, Stan Gustafson, Gordon Hensley, Dave Mayfield, Virgil Just, Paul Reynolds, Dr. Thomas Ruehr, Bob Semenson, and Stan Stein. Each one of these individuals has contributed enormously to the sustained development of the current Wastewater Project, both individually and several as members of the Los Osos Community Services District Board of Directors and/or the several CSD committees. Each of these individuals has been available whenever information and support were needed.

Paavo Ogren, Interim General Manager of the Los Osos Community Services District (CSD), provided assistance in obtaining County mapping and relevant engineering reports and during our contract negotiations with Los Osos CSD attorney Jon Seitz. Bruce Buel, the new Los Osos CSD General Manager provided great assistance and encouragement during the preparation of this Draft Project Report; Wastewater Project Manager Mark Ysusi of Montgomery Watson provided strong leadership in coordinating the Wastewater Project and the multi-disciplinary Wastewater Project Team and assistance in evaluating our preliminary construction cost estimates and earlier drafts of this report; George Milanés, Los Osos CSD Utilities Manager, for his many suggestions regarding operation and design considerations for the AIWPS® Facility, as well as information on the water supply and water quality within Los Osos.

We wish to acknowledge Frank Freiler, Jerry Gregory, and Bob Semenson who have been especially helpful to us and our STEG/STEP design engineer, Bill Bowne, in comparing with us the results of their several countings of prospective STEG/STEP connections, existing DUEs, and full buildout DUE projections based on future development potential within the Urban Reserve Line and for their on-the-ground assistance with Bill Bowne's preliminary layout of the wastewater collection facilities. Special thanks are also due to Don Asquith for his valuable information on the Los Osos groundwater basin and to Dan Panetta for his initiative and continued interest and promotion of the AIWPS® Technology.

We especially wish to thank our landscape design colleagues at SWA Group, especially Joe Runco, James Lee, Lisa Crounse, and Nancy Conger for their help in integrating the AIWPS® Wastewater Treatment and Water Purification Facility and drainage plan into the Resource Park and for their many iterations in site planning and layout and for their dedication and long hours throughout the holidays; Gary Grimm for his environmental legal counsel and experience with the regulatory process; Steve Grinnell of Navigant Consulting/Bookman Edmonston for his assistance with the groundwater monitoring program, the drainage plan for the Resource Park, and other general engineering support; Chris Clark of Multari, Clark, Crawford & Mohr for their advice on the environmental aspects of the project; Tim Cleath and Spenser Harris of Cleath and Associates for their hydrogeological expertise in investigating further the candidate disposal sites and disposal methods; Jon Blanchard of CFS Geotechnical Consultants for his continued geotechnical investigations of the Resource Park. We also wish to thank John Wallace, Assessment District Engineer; Saul Rosenbaum Finanncial Consultant; and Carlo Fowler, Bond Counsel for the financial planning work that they have begun.

We also thank Mike Wulkan at the County Planning Department who provided us with their latest planning documentation for Los Osos. We also wish to thank members of the staff of the State Water Resource Control Board, Farouk Ismail, Howard Whitver, Jim Marshall, and Ron Blair and members of the staff of the Regional Water Quality Board, Central Coast Region, especially Sorrel Marks, Brad Hagemann, and Roger Briggs for their interest and support, questions, suggestions regarding the development of the Los Osos Wastewater Project.

ACKNOWLEDGMENTS

This report was prepared and assembled by Bill Oswald and Bailey Green with assistance from Tryg Lundquist, Bill Bowne, Steve Grinnell, Joe Runco, Chris Clark, Jon Blanchard, Tim Cleath and Spencer Harris, and Mark Ysusi. Finally, we wish to thank those members of the CSD Board of Directors, committees, and staff, and the other Wastewater Project Consultants who reviewed earlier drafts and helped to refine the Draft Project Report.

The Los Osos Community Services District is located in Los Osos on the southeast shore of Morro Bay in the County of San Luis Obispo and, with respect to wastewater, in the jurisdiction of the State of California Water Resources Control Board, the California Regional Water Quality Control Board, Central Coast Region, the California Coastal Commission, and many other federal, state and local agencies.

As a mainly bedroom and recreational community located on ancient sand dunes, it has been possible for individual residences and small commercial establishments to utilize septic tanks for primary sewage treatment and leach fields and seepage pits for disposal of septic tank effluent. The septic tank effluent drains into a shallow "upper aquifer" which is basically a sandy prism 0-feet to 150-feet thick underlain by a cup-shaped impervious clay layer that slopes downward at about a 1% slope toward Morro Bay. This impervious layer evidently prevents intrusion of water from the upper aquifer into the major community water supply in the Paso Robles Formation just below. This formation yields an apparent abundance of excellent water with a total dissolved solids (TDS) concentration near 250 mg/L and low levels of sulfate and other minerals.

The upper aquifer is apparently in part flushed and diluted by rainwater as it moves laterally along the aquatard that slopes down toward Morro Bay, but the aquifer may have internal discontinuities (Brown and Caldwell, 1984). This is evidenced by the fact that although the shallow aquifer could potentially receive as much as 60 metric tonnes of nitrogen from septic tank effluent each year, there are many zones with virtually no nitrogen and only a few zones where nitrate concentrations exceed the maximum contaminant level for drinking water of 10 mg/L as N. There is also evidence that nitrification and denitrification occur in unsaturated zones below septic leach fields and seepage pits contributing to diminution of nitrogen input to the aquifer. Nevertheless, there is evidence that nitrogen levels are increasing in many areas.

Following passage of the Porter Cologne Act in 1972 and based on the documented presence and increasing concentration of the health-related ions, nitrite and nitrate, presumably from septic tank effluent, the California Regional Water Quality Control Board, Central Coast Region, amended the Basin Plan and adopted Resolution 83-13 prohibiting the use of septic tanks and leach fields or seepage pits in much of the community of Los Osos. Three major engineering studies followed. Each concluded there was a need for gravity sewers for the entire community followed by a mechanical wastewater treatment facility designed to remove nitrate.

Which mechanical process removes nitrogen?

All of these studies were rejected by the community for various reasons, mainly cost, and a desire by the community to retain their septic tanks, to have a more natural system for wastewater treatment in a park setting that would safeguard and enhance groundwater quality and permit beneficial reuse of reclaimed wastewater, minimize energy use, and that would be managed by the Community itself (Los Osos Community Advisory Council's Vision Statement approved June 22, 1995). Because of these interests, community action eventually resulted in elective creation of the Los Osos Community Services District (Los Osos CSD or LOCSD) on January 1, 1999 and authorization of the current study on July 29, 1999 embodying the following plan:

- to retain septic tanks installed and managed by experts in septic system management;
- to use a modern septic tank effluent gravity and septic tank effluent pumped (STEG/STEP) collection system for most of the community;
- to treat septic tank effluent to tertiary quality with low effluent total nitrogen using an Advanced Integrated Wastewater Pond System or AIWPS® Facility in the centrally located Resource Park; and,
- to dispose of the disinfected tertiary wastewater effluent through gravity wells located in an area where the shallow aquifer water surface is at least 50 feet below ground surface and at a depth where the discharged water will not surface downslope;
- to reuse the disinfected tertiary wastewater effluent for irrigation within the Resource Park and other landscaped areas within the community;
- to improve groundwater quality and to safeguard its beneficial uses; and,

- to protect and preserve local water resources including the groundwater basin and Morro Bay.

Section 1 of the Draft Project Report addresses the needs of the community and the benefits of the proposed Wastewater Project. Section 1 addresses the health-related problems associated with nitrate concentrations above the maximum contaminant level for drinking water in the shallow groundwater and shallow wells and the threat of contamination of the confined Paso Robles aquifer which is the main source of hygienic drinking water for the present and future community.

A STEG/STEP collection system is proposed because the community can retain its investment in septic tanks and minimize the cost and additional treatment capacity that would be required by a conventional collection system. The AIWPS® Technology is proposed for treatment because it minimizes energy use, converts most of the nitrogen removed from the wastewater into either nitrogen gas or useable nitrogen-rich fertilizers, and provides scenic water surfaces free of objectionable odors. This natural treatment system can also accommodate the treatment of septage and provide a natural park setting with potential for native plant and animal habitat including several species of arthropods and gastropods. The AIWPS® Facility will: (1) fully protect the public health; (2) protect water quality, and (3) provide recreational open space, environmental mitigation, and educational benefits as well.

AIWPS® Facilities remove nitrogen in five ways:

- by conversion of organic nitrogen to nitrogen gas (N_2) through heterotrophic nitrification and denitrification;
- through aerobic nitrification and denitrification;
- through assimilation of ammonium by algae grown in High Rate Ponds which when removed and dried are generally 5-10% nitrogen by weight;
- by ammonia volatilization in High Rate Ponds and on paddle wheel surfaces; and,

- by the final removal of algal and bacterial solids using dissolved air flotation and filtration.

By discharging 90% of the disinfected tertiary effluent into the shallow aquifer through gravity wells, we estimate that it will require approximately 20 years for the shallow aquifer to reach 7 mg/L as N: 17 years in the western sub-basin and 21 years in the eastern sub-basin. We further estimate that it will take 41 years in western sub-basin to reach 5.2 mg/L as N and approximately 50 years in the eastern sub-basin for shallow groundwater quality to reach 5.8 mg/L, concentrations that approach the Basin Plan groundwater objective of 5 mg/L as N.

Section 2 addresses the cost effectiveness evaluation of alternatives. The cost effectiveness of AIWPS® Facilities is embodied in its many savings in construction costs, elimination of raw sludge handling, and when mature, savings in personnel time and electrical energy. Systems to be upgraded are septic tanks that are no longer sound or need to be upgraded to minimize infiltration and inflow to the collection system. STEG/STEP is a mature technology that in sandy areas may save as much as half the cost of conventional gravity sewers. The present worth of the entire proposed Wastewater Project is $74.3 million (M) including $51.1 M in capital and $0.9 M in operation and maintenance (O&M) costs over 50 years at a 4.1% interest rate brought back to present value. This present worth may be compared with gravity sewers and activated sludge/sequencing batch reactors (Modified Ludzack-Ettinger® Process) for which the most recent present worth cost estimate is $84 million for Phase 1 including $58.9 in capital costs and $1.2 in annual O&M costs spread over 50 years using a 4.1% interest rate and brought back to present value according to the RWQCB Los Osos/Baywood Park Workshop held on September 9, 1999. It is important to note that the current Wastewater Project is for full buildout capacity (not an initial phase) and includes $13 M for land and environmental mitigation, $0.9 M for new roads and road improvements; $2.9 M for the creek and drainage corridor (drainage management system) at the Resource Park, in addition to $7.0 M for the STEG and STEP septic tank retrofits and connections.

incorrect

bot = fraction of the "Phase I" project above.

Section 3 evaluates liquid and solid disposal alternatives for the proposed Wastewater Project. The STEG/STEP Collection System should convey little sludge to the AIWPS® Facility and any sludge introduced, along with grit-free septage, will be digested to completion and hence will not require sludge removal to retain process volume. Algae produced during photosynthetic oxygenation will be removed dried and stockpiled until its bacterial content has died away sufficiently to meet Class A biosolids requirements for safe fertilizer. Although algal solids may be used for fertilizer when disinfected, grit and refractory residuals removed from the septage receiving station each year will be hauled to an appropriate site, such as Cold Canyon, for final disposal.

Section 4 addresses infiltration and inflow. Infiltration and inflow are minimized in STEG/STEP Collection Systems because STEP systems are pressurized and because STEG systems are built in shallow trenches and are generally small in diameter. The most likely intrusion of I&I is at the septic tank house connection which will be carefully inspected and, if necessary, replaced to minimize such inflow. A 25% excess allowance of flow from the tanks is assumed for the wet weather septic tank effluent. The AIWPS® Facility ponds have a two-foot freeboard thoughout to capture rainfall events. AIWPS® Facilities are not sensitive to I&I because of their huge volume compared to daily flow.

25% of 49 gal still nowhere near industry standard of 100 gpd/c

Section 5 addresses project costs. The total capital cost of the Wastewater Project is estimated to be \$51.3M. This estimated project cost includes a 30% contingency and a 20% allowance for engineering and administration services. With annual operation and maintenance cost estimated at \$0.9M, and using 4.1 % interest over 50 years, we find that the present worth of the project is \$74.3M. Each new individual dwelling unit (DU) will be required to pay for their new septic tank with either a STEG or STEP retrofit package.

Section 6 addresses flows and population. The current population is approximately 15,000 population equivalents (PE) with an expected 2020 build-out population of 19,000 PE. This is lower than previous expectations because some of the parcels previously assumed for development are to

estero plan estimates more ~23000

be occupied by the 70-acre Resource Park, and a habitat mitigation area (Morro Palisades) of 206 acres. If fully developed, these areas would have encompassed more than 550 DUs and a likely population of 1,375 PE. Studies of septic tanks by authorities in the Water Pollution Control Federation estimate mean septic tank flow at 49 gallons per person per day. To account for infiltration in STEG/STEP systems (unlikely to be high), we have assumed a flow of 65 gallons per person per day during storms. Although conventional sewerage systems normally utilize 100 gallons per capita per day as a design average, as will be explained in the text, such volume assumptions would be excessive for a STEG/STEP system particularly in Los Osos where water consumption is below average. Water production data when corrected for losses amounts to metered flow of about 70 gallons per capita per day and with outdoor irrigation, only about 49 gallons per capita per day enter the houses and residential units.

EPA (Kriessel Report) indicated opposite LO has above ave water use.

By 2020, it is assumed that 76% of the dwelling unit equivalents (DUEs) will be collected by the STEG/STEP Collection System. The dry weather flow for a collected buildout population of 14,500 at 49 gallons per person per day will be 710,500 gallons per day, and during wet weather 942,500 gallons per day excluding in-pond rainfall and evaporation. The AIWPS® Facility at St. Helena, California has accepted short-term hydraulic overloads of more than five-times the rated capacity (Milanés, personal communication) without severe reduction in treatment efficiency. The reality is that in wastewater pond systems, organic load is far more important than hydraulic load. We have provided for fermentation and aeration sufficient to deal with the organic load with a safety factor of 1.5.

Section 7 addresses the State Revolving Fund eligibility of the proposed Wastewater Project. The ultimate BOD (Table 8-1) of the combined STEG/STEP effluent and septage is estimated to be 225 mg/L, or for the expected build-out flow of 1 million gallons per day, approximately 2,800 pounds per day. Seventy-horsepower of aspirating aerators are provided to mitigate any odors should they be threatened, particularly during dark, warm periods in the fall.

what about that added by hauling solids >400 more realistic

The anticipated eligible capacity for the Wastewater Project is one million gallons per day. This is for a buildout population on the STEG/STEP system of about 19,000 PE. Septic tanks as they are installed, retrofitted, or replaced will be required to have a life expectancy of 40 years. We have knowledge of concrete tanks that are 60 years old and still function satisfactorily. Tanks that need replacement in locations difficult to reach, will be fiberglass or plastic because concrete tanks are too heavy. All tanks in accessible locations will be concrete.

Section 8 describes the selected wastewater facilities alternative. The best practicable wastewater treatment technology for septic tank effluent is a lagoon system. The AIWPS® Technology was derived from the well-known fact that a septic tank or Imhoff tank followed by a lagoon is a widely used, highly satisfactory system, with the exception that suspended solids and pseudo-BOD often exceeded discharge requirements. In effluents with algae removed, one usually finds a BOD of less than 20 mg/L and, of course, no suspended solids. The AIWPS® Wastewater Treatment and Water Purification Facility proposed for Los Osos will have physical removal of virtually all algal-bacterial suspended solids, and because the system is designed especially for tertiary treatment, effluent will likely have BOD less than 10 mg/L and a total nitrogen of less than 5 mg/L when mature.

Section 9 addresses the issue of public participation. Public participation in the Wastewater Project at Los Osos has been exemplary. Public participation has occurred in more than 20 public meetings culminating in an election in which more than 75% of the voters turned out to vote and voted by an 87% majority to create the LOCSD. Public hearings and public participation activities have been ongoing since the formation of the LOCSD, and upcoming public hearings and town meetings are scheduled including EIR and assessment hearings and town meetings relating to wastewater facilities planning through the next ten months.

Section 10 provides additional information regarding the selected alternative. The selected alternative consists of managed septic tanks; a STEG/STEP Collection System; a septage receiving,

to what benefit?

blending, and settling (pretreatment) facility; an AIWPS® Facility including two Advanced Facultative Ponds, four High Rate Ponds, two Algae Settling Ponds, two Dissolved Air Flotation units for algae removal, final filtration and final disinfection.

The system is designed to collect and treat septic tank effluent from a maximum buildout collected population of 14,500 and septage from a maximum buildout population of 19,000. Maximum dry weather flow is 710,000 gallons per day and wet weather flow of 1 million gallons per day. The design is for ultimate BOD load of 2,800 pounds per day and suspended solids of 860 pounds per day
where is septage (at 40,000 mg/L) accounted for?
(septic tank effluent is low in suspended solids). No excess sludge will be produced that requires disposal. Algae solids will be sun-dried and stockpiled for 6 to 12 months until they meet U.S. EPA requirements for biosolids. Final effluent should have a BOD of the less than 10 mg/L and a total nitrogen content of less than 5-6 mg/L.

Construction cost for the entire STEG/STEP collection, the AIWPS® Facility, and dry well disposal including 30% contingency and a 20% allowance for engineering amounts to $51.4 million. The operation and maintenance cost is estimated to be $900,000 per year. for $7.5 million more could sewer entire area

Cost impact on the community remains to be determined as the finance plan is further developed and assessment allocations are finalized.

The environmental impacts and potential mitigations of the Wastewater Project are underway drawing upon the environmental work that was done previously on earlier proposed wastewater projects, especially the most recent County project planned by Metcalf & Eddy. Habitat mitigation requirements are being evaluated, and potential mitigation costs have been included in the cost estimates for the proposed project.

A hydrogeological investigation is underway for three candidate disposal sites, and the latest basin model is being developed. It should reveal in greater detail groundwater resource information not previously available. No wastewater facilities at Los Osos were previously funded by Federal or State grants or loans. The Civil Rights Act of 1964 *et ceq.* will be complied with, and all minorities will be provided service without discrimination.

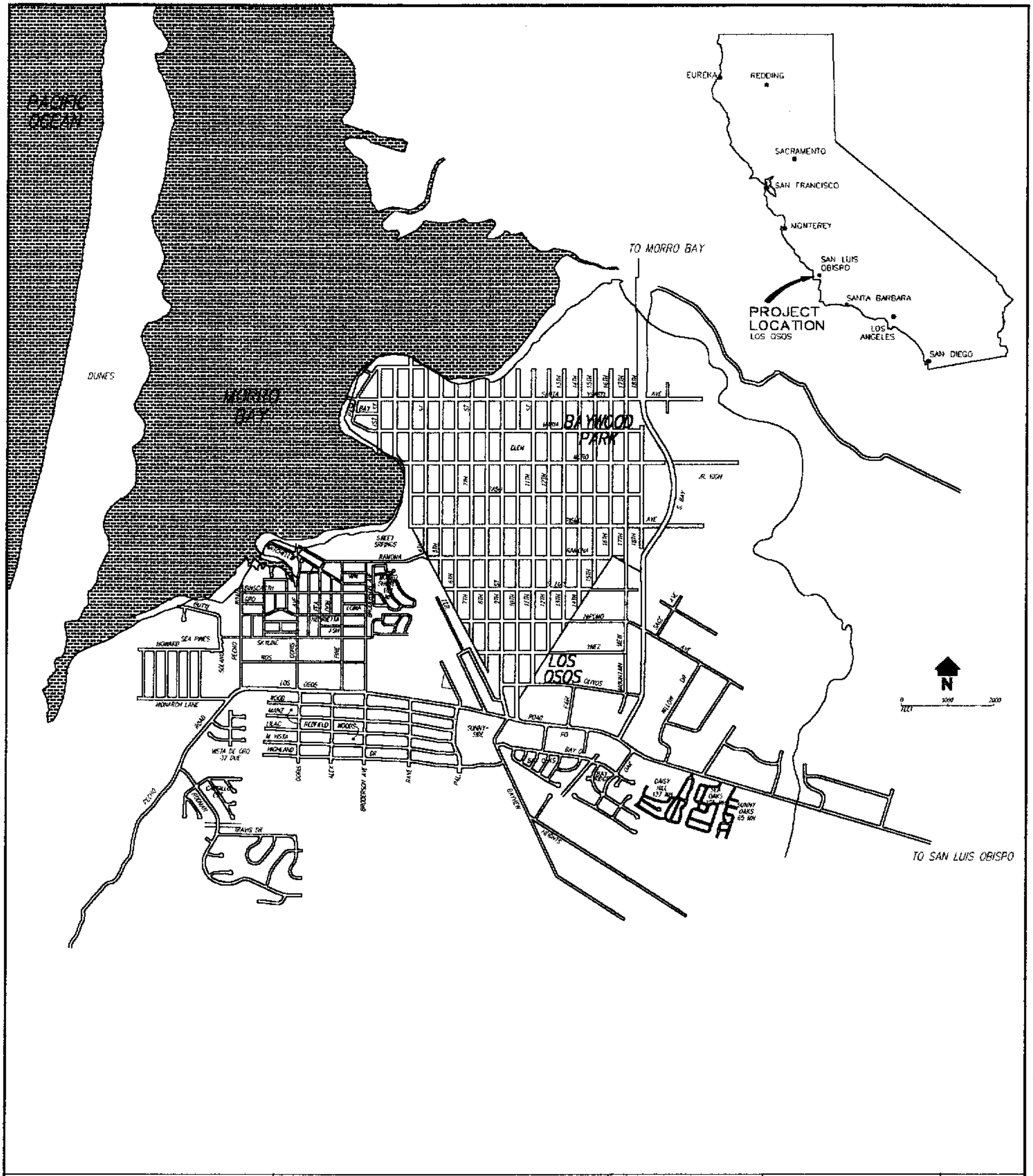
A description of operation and maintenance procedures for the entire Wastewater Project should be prepared after detailed design and manuals of operation and maintenance for project components will be provided during the construction phase.

A demonstration that the proposed Wastewater Project can satisfy the draft waste discharge requirements and the overall objectives of the Basin Plan is provided by data from demonstration-scale studies at the University of California's Engineering Field Station in Richmond, California and by monitoring studies at full-scale AIWPS® Facilities. These studies and illustrative AIWPS® Fa cility performance data are presented in Section 8. Public participation in the proposed Wastewater Project has been exemplary, as is described in Section 9. A copy of the draft waste discharge requirements for the previous County wastewater project is included in Section 10.

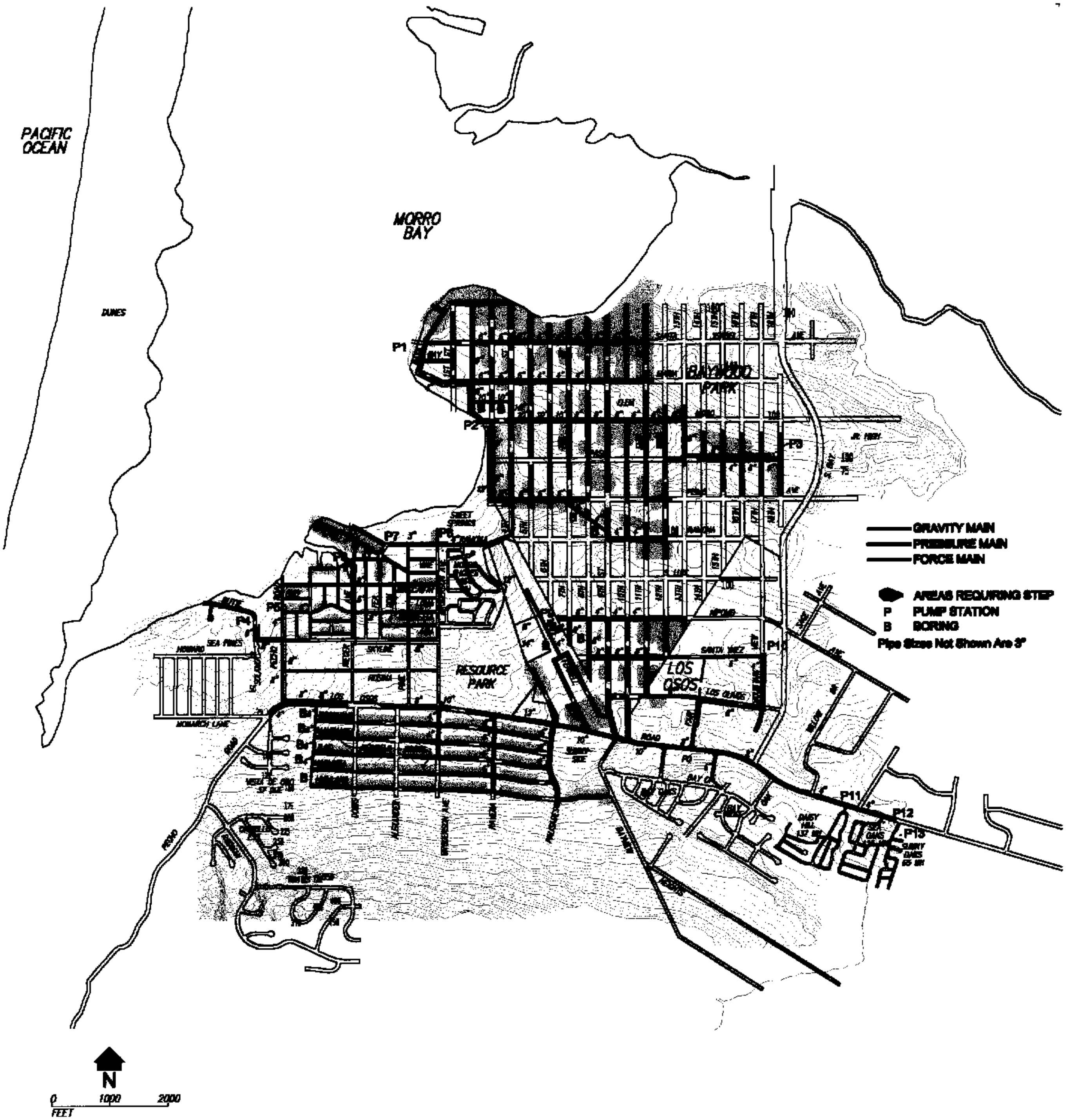
PROJECT DESCRIPTION

The community of Los Osos, California is located on the southern edge of Morro Bay in the County of San Luis Obispo as is shown in Figure 1-1 and Figure 1-2. Since its modern settlement began, residences, schools, and commercial developments in Los Osos have been served by septic systems. Because the community of Los Osos depends upon the local groundwater basin for its drinking water supply, water quality and supply within the groundwater basin must be protected and managed. The Los Osos groundwater basin is shown in Figure 1-3 and Figure 1-4. The Los Osos groundwater basin consists of at least two major aquifers: a relatively shallow, upper aquifer (or cluster of shallow water bearing strata) and a much deeper, lower aquifer. Shallow groundwater elevation contours and depth contours are shown in Figure 1-5 and Figure 1-6. The upper and lower aquifers are separated by several impervious layers. The Los Osos groundwater basin is also crossed by the Los Osos fault that runs along the north-south axis near the eastern boundary of the Resource Park site. Los Osos faults add further hydraulic discontinuity within the Los Osos groundwater basin. Despite the hydrogeological complexities within the Los Osos groundwater basin that have been the subject of several groundwater basin investigations, the State Regional Water Quality Control Board and the community of Los Osos have been concerned with the potential, and in some instances, the indicated degradation of water quality in the shallow aquifer resulting from an increase in nitrate concentrations and the presence of coliform bacteria. While the limited groundwater quality data are contradictory and do not support a single homogeneous trend toward increasing nitrate and coliform concentrations, and while several sources for elevated nitrate concentrations in the shallow aquifer have been identified, in addition to discharge from septic systems, the existing septic systems have been implicated as a potentially controllable source of nitrate and coliform contamination in the shallow aquifer. Figure 1-7 shows the layout of the septic tank effluent collection system by which this source of nitrate and coliform will be diminished by 76%, that

reduce N by 76% while sewering X% of DUE!



LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	PROJECT MAP	SOURCE: SAN LUIS OBISPO COUNTY DATE: JAN. 3, 2000	FIGURE **1-1**



DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	STEG/STEP SEWER MAIN RETICULATION COLLECTION AREA	DESIGN: WCB DATE: JAN. 31, 2000	FIGURE **1-7**

is, the collected population at full buildout. Furthermore, the perceived inadequacies of the existing septic systems, especially those installed prior to septic system standards and unified code requirements, led to the imposition of several regulatory orders issued by the Regional Water Quality Control Board (RWQCB) beginning in 1983 with Resolution 83-13 in which discharge is prohibited from individual and community sewage systems within the Prohibition Area of Los Osos. Subsequently, a building moratorium was imposed on Los Osos in 1988.

In response to these existing conditions and prohibitions, and in an effort to protect, preserve, and enhance water quality within the local groundwater basin, the community of Los Osos led by the Los Osos Community Services District (CSD), whose formation was established by an 87% majority vote with a voter turnout of 75% in November 1998, initiated a comprehensive Wastewater Management Project (Wastewater Project) beginning in January 1999 by hiring staff and issuing Requests for Qualifications and Requests for Proposals from a broad range of consultants and areas of expertise.

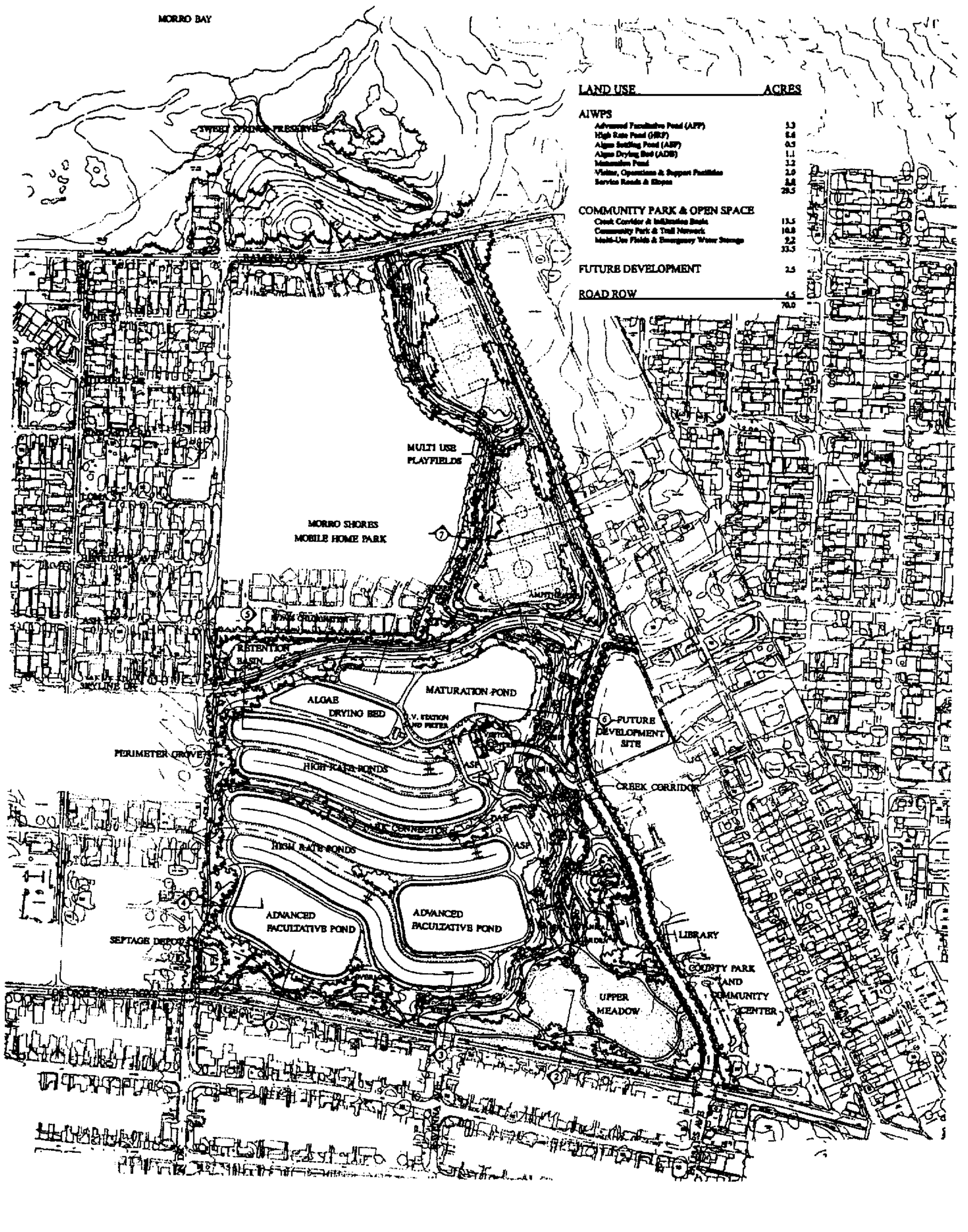
change in history

The Wastewater Project includes the development and implementation of a comprehensive wastewater management program including water conservation and protection and enhancement of water quality within the groundwater basin and the Morro Bay Estuary; and, planning, design, construction, and operation of facilities for the collection, treatment, and disposal of wastewater and septage within the community of Los Osos. The wastewater management program will include both wastewater facilities operations and a Septic System Maintenance and Management Program (SSMMP) that will provide inspection and maintenance of septic systems and the receiving and treatment of septage within the area defined by the Los Osos Urban Reserve Line (Figure 1-2). The Wastewater Project is being directed by the Los Osos CSD to serve the needs and to provide water resource management and environmental benefits to the Community of Los Osos.

The wastewater collection facilities consist of the existing building sewers and septic tanks that will be replaced or retrofitted and collected with either a septic tank effluent gravity (STEG) or septic tank effluent pumping (STEP) collection system and a series of approximately 13 pumping stations (Figure 1-3). Where the lot sizes are sufficiently large, or where the separation between the ground surface and groundwater is 30 feet or greater, these existing and future septic systems are not recommended for collection and treatment. The Wastewater Project STEG/STEP Collection Area is approximately 64 % of the developed area or potentially developable area and approximately 76% of the existing and maximum buildout population living within the Prohibition Zone.

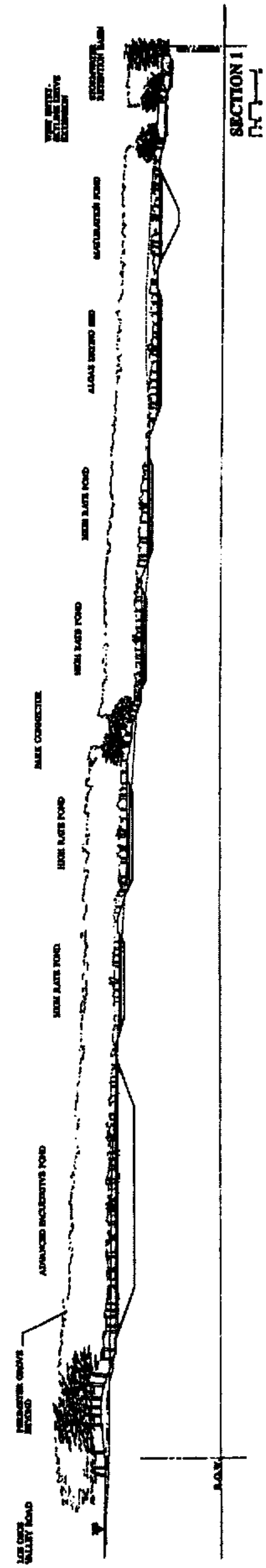
what is "sufficiently large" ½ acre?

The wastewater treatment facilities consist of a series of ponds, each specially designed to provide one or more unit processes in the treatment and purification of wastewater. The wastewater facilities utilize the Advanced Integrated Wastewater Pond Systems® Technology or AIWPS® Technology. As described in further detail in Section 8 and Section 10 and as depicted in Figures 1-8 through 1-13, the proposed AIWPS® Wastewater Treatment and Water Purification Facility (AIWPS® Facility) located at the Los Osos Resource Park will consist of two parallel, primary ponds known as Advanced Facultative Ponds (AFPs), followed by two parallel, primary High Rate Ponds (HRPs), followed by an Algae Settling Pond (ASP), followed by a Dissolved Air Flotation (DAF) clarifier, followed by two parallel, secondary HRPs, followed by a second ASP, followed by a second DAF, followed by a single, three-cell, intermittently backwashed sand filter, followed by a single 7-bank UV disinfection unit. The tertiary treatment elements–two DAF clarifiers, sand filter, and UV disinfection unit--add to the capital and O&M cost of the proposed AIWPS® Facility, but also insure further reduction in effluent nitrogen concentrations, complete disinfection, and compliance with discharge requirements as drafted by the RWQCB for the County wastewater project. There is also an emergency bypass and disposal system included in the

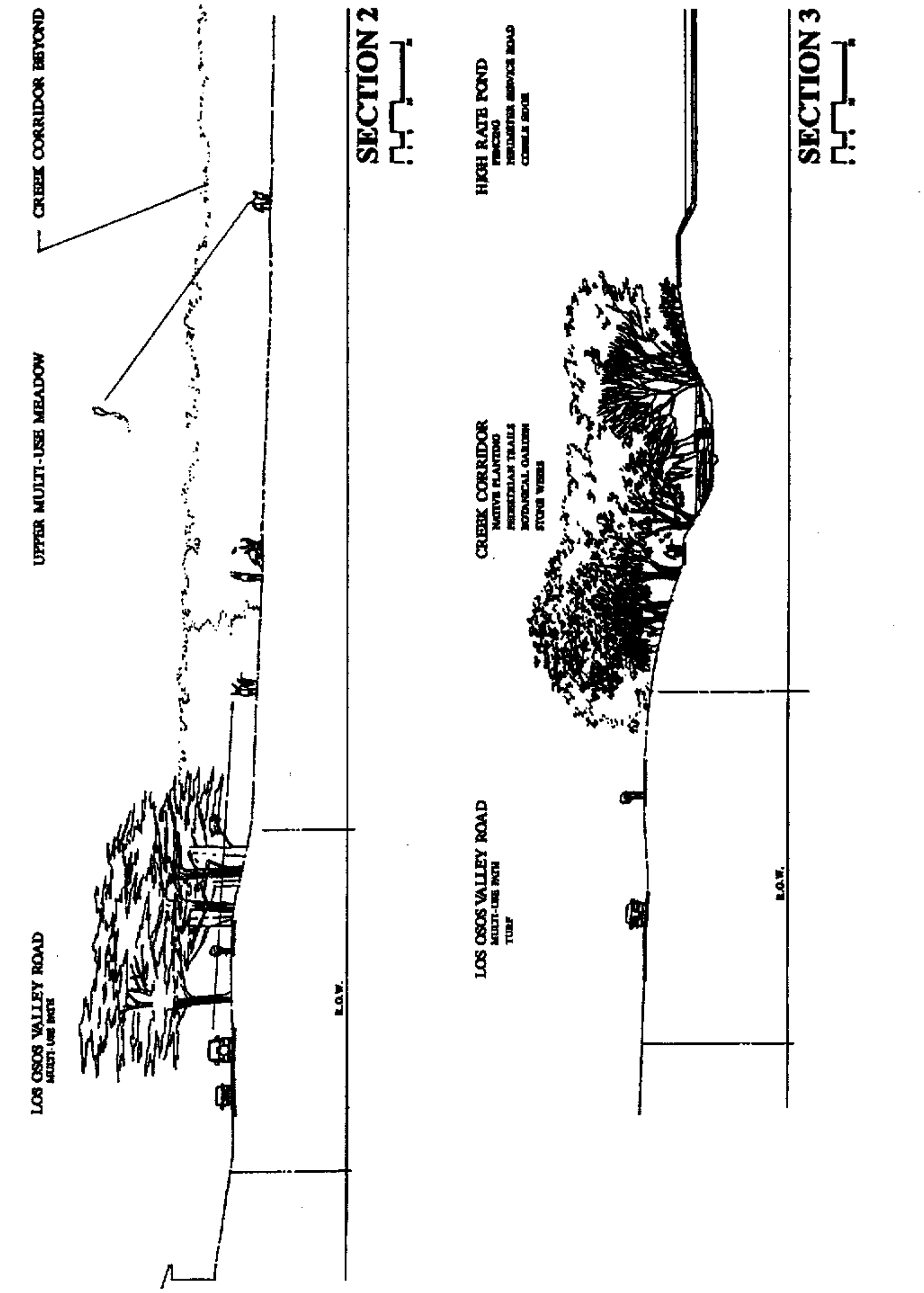


LAND USE	ACRES
AIWPS	
Advanced Facultative Pond (AFP)	5.3
High Rate Pond (HRP)	8.6
Algae Settling Pond (ASP)	0.5
Algae Drying Bed (ADB)	1.1
Maturation Pond	3.2
Visitor, Operations & Support Facilities	2.0
Service Roads & Slopes	8.8
	29.5
COMMUNITY PARK & OPEN SPACE	
Creek Corridor & Infiltration Basin	13.5
Community Park & Trail Network	10.8
Multi-Use Fields & Emergency Water Storage	9.2
	33.5
FUTURE DEVELOPMENT	2.5
ROAD ROW	4.5
	70.0

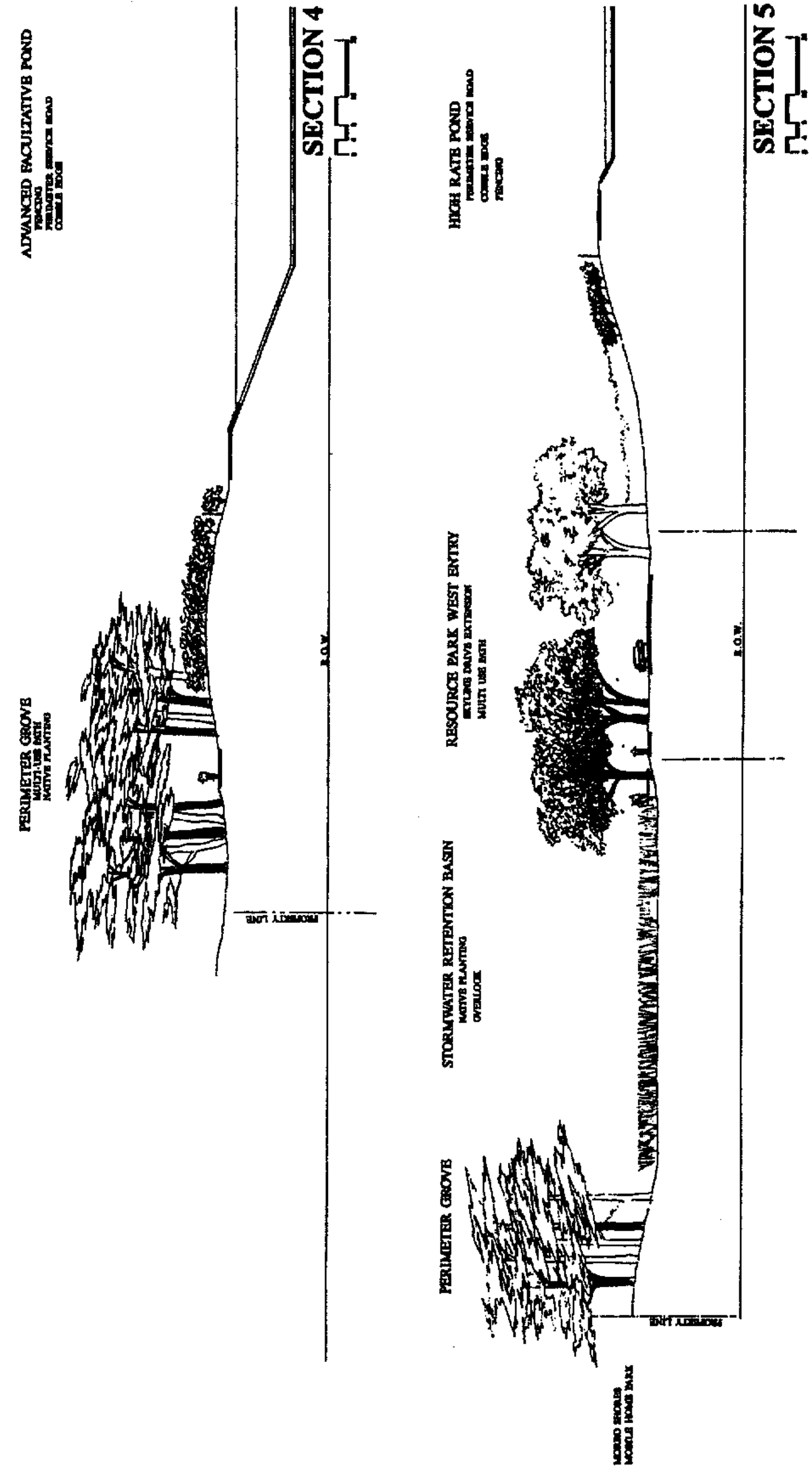
DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	RESOURCE PARK SITE PLAN	SOURCE: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-8**



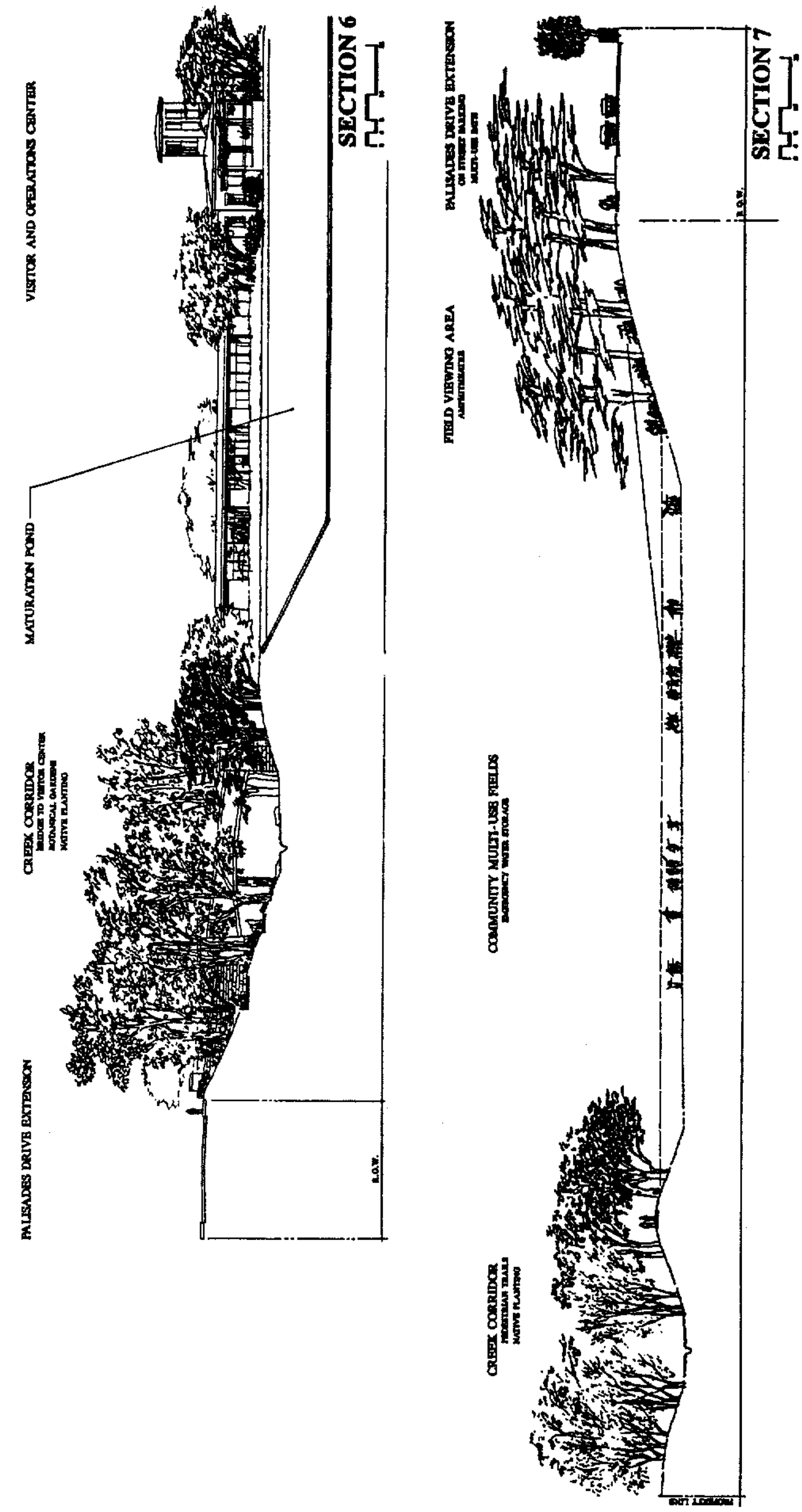
DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-9**



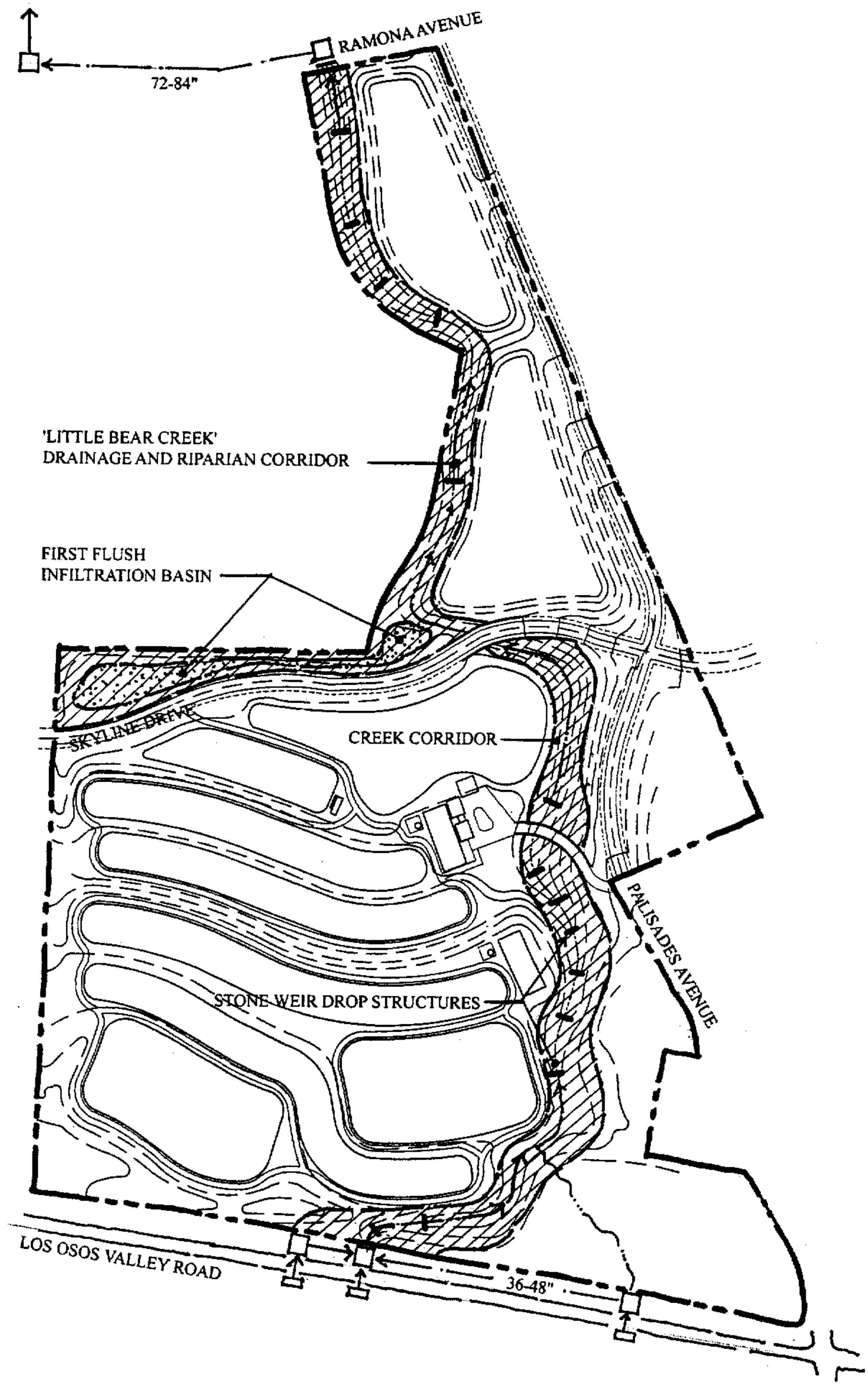
DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-10**



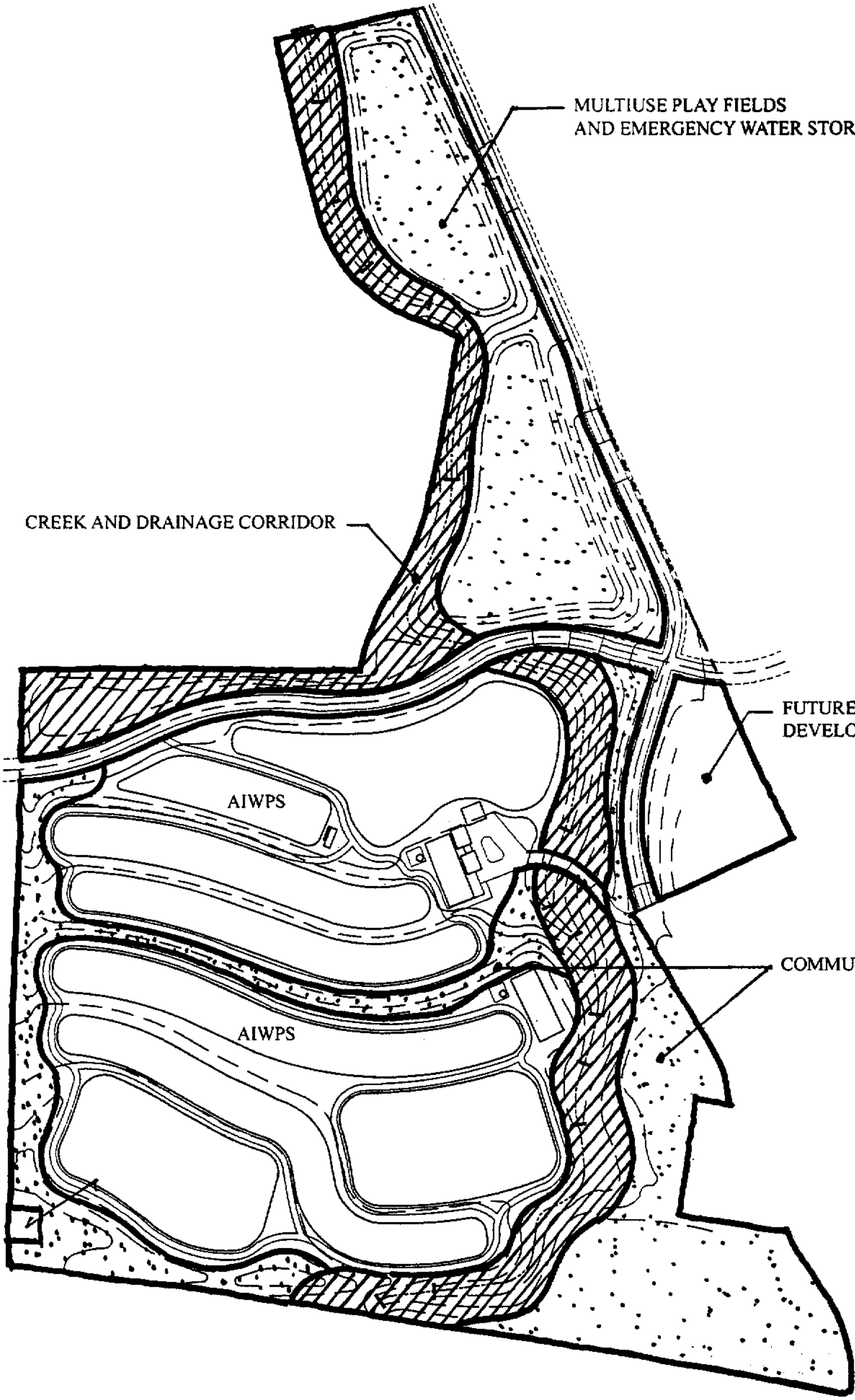
DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-11**



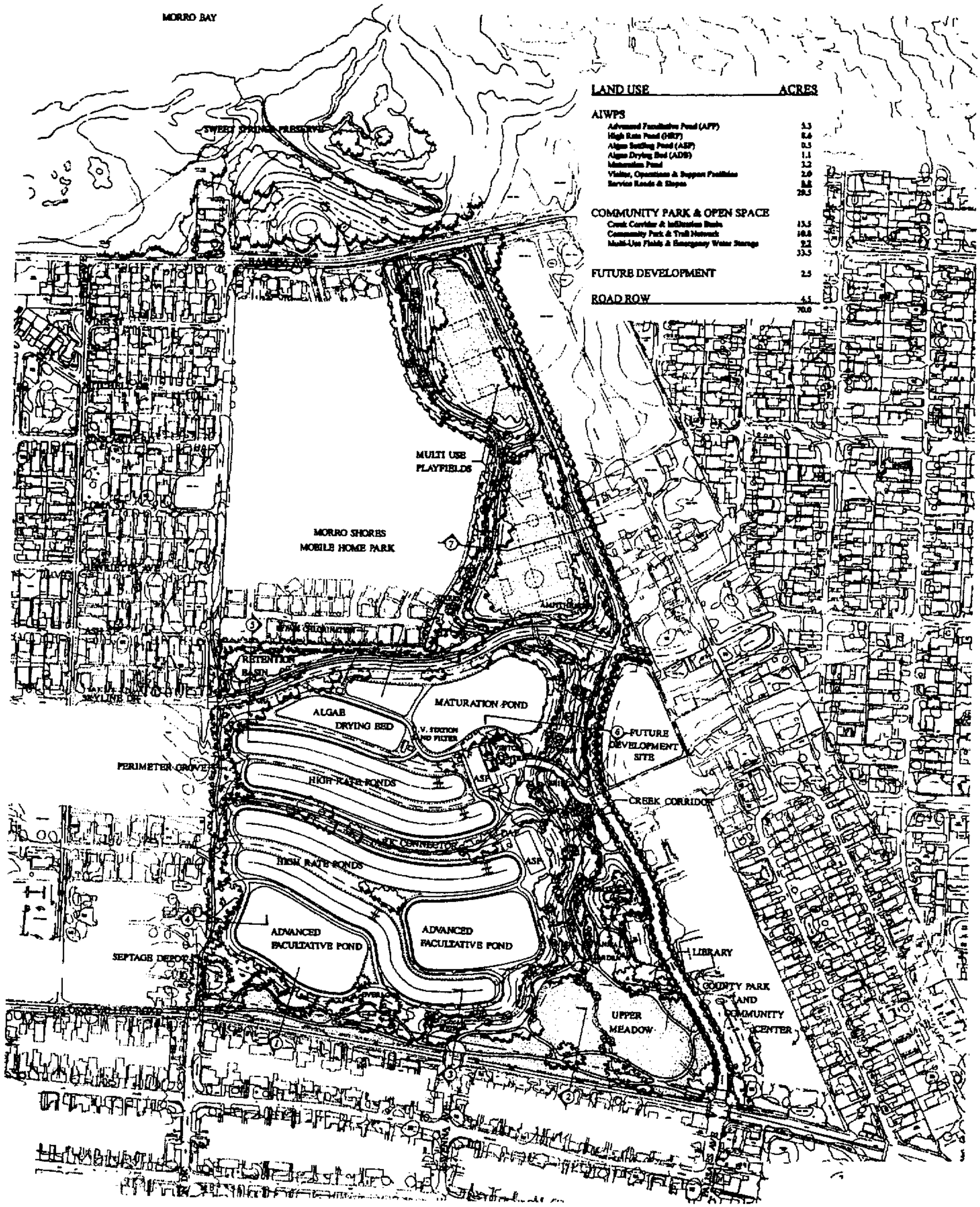
DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31. 2000	FIGURE **1-12**



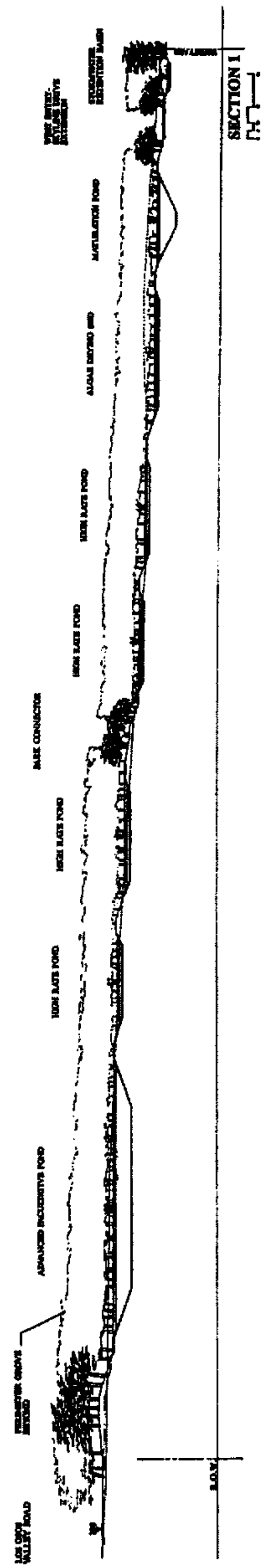
DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	STORM DRAIN SYSTEM	SOURCE: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-13**



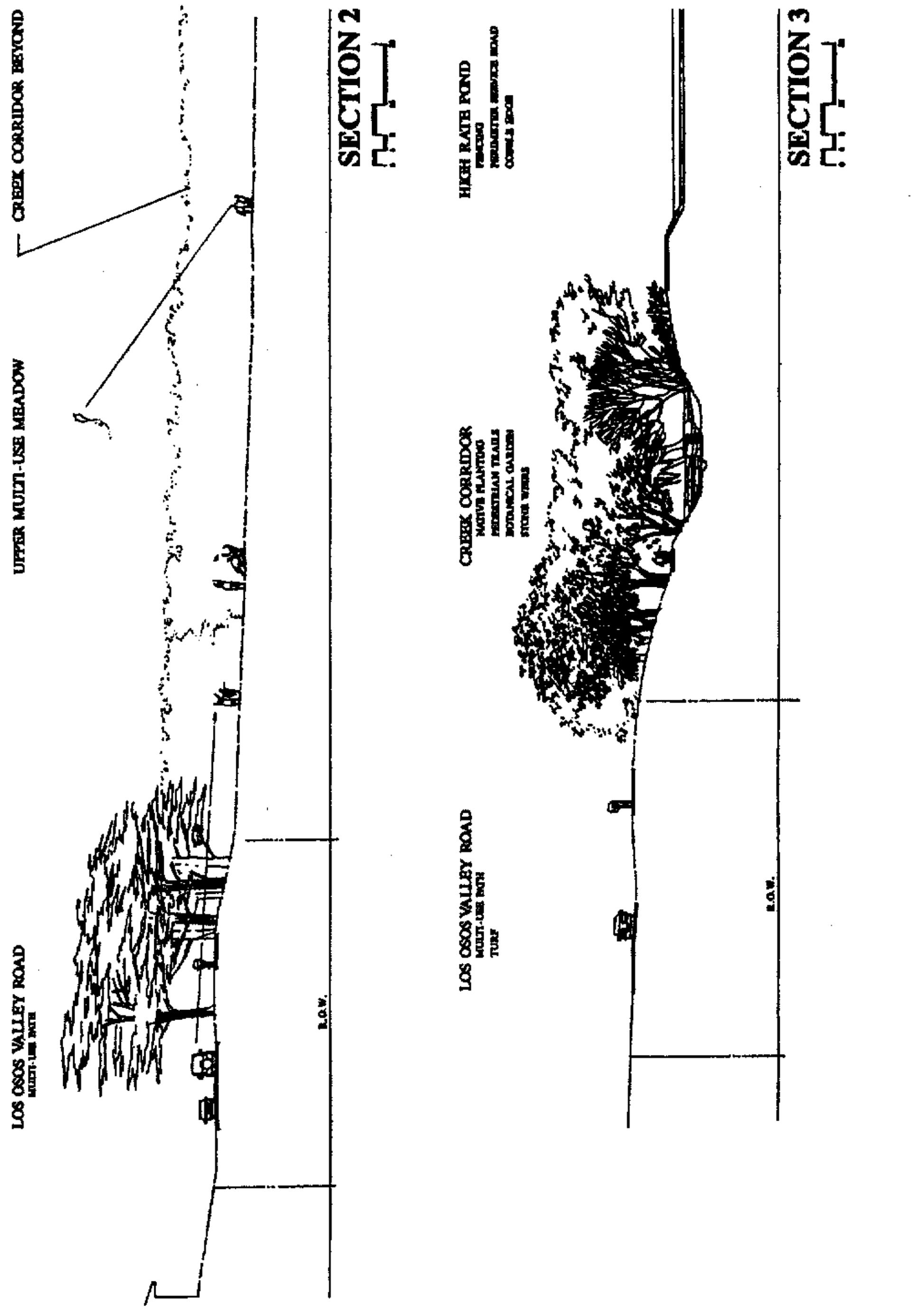
DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	COST ESTIMATE AREAS	SOURCE: SWA GROUP DATE: JAN. 31, 2000	FIGURE 5-2



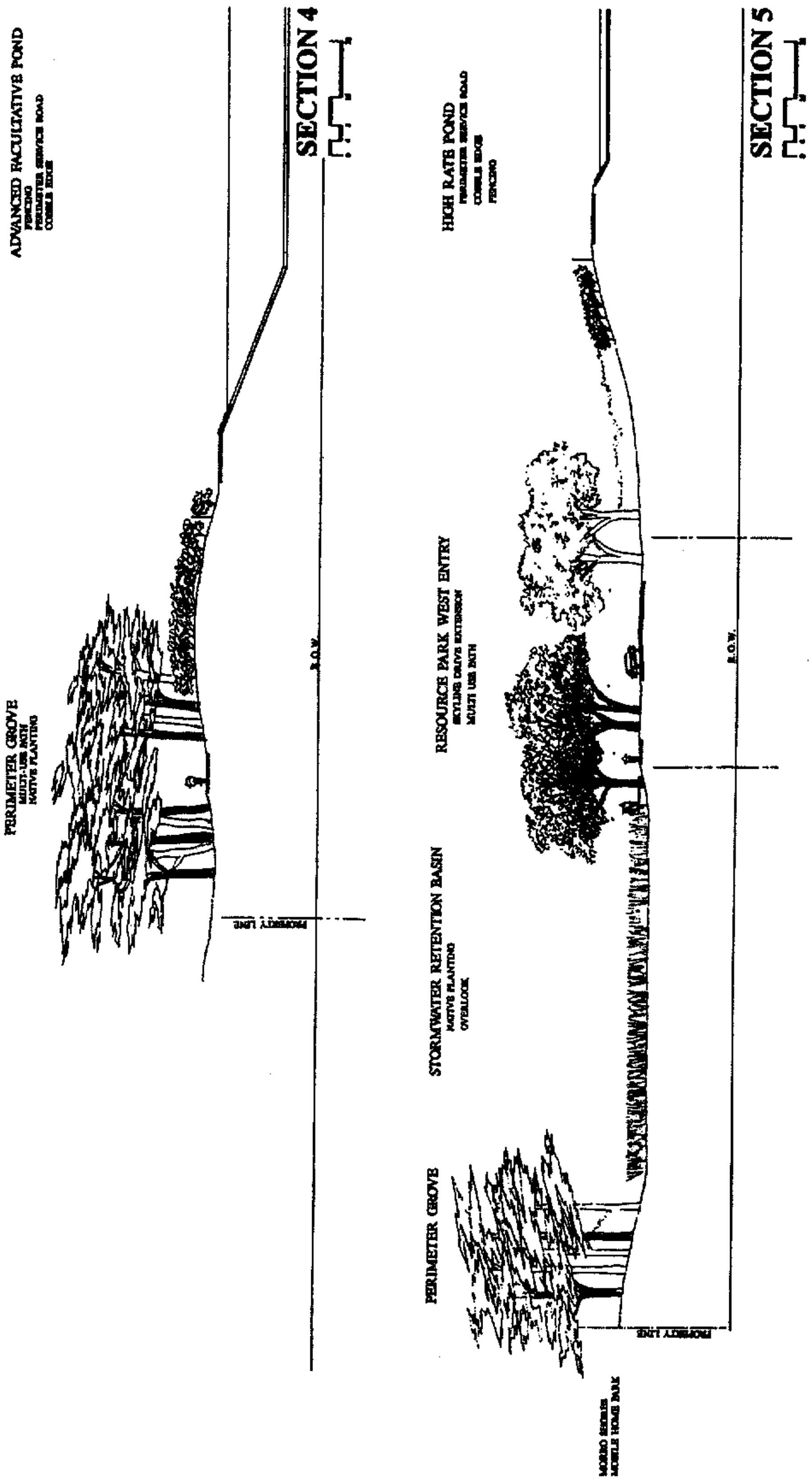
DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	RESOURCE PARK SITE PLAN	SOURCE: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-8**



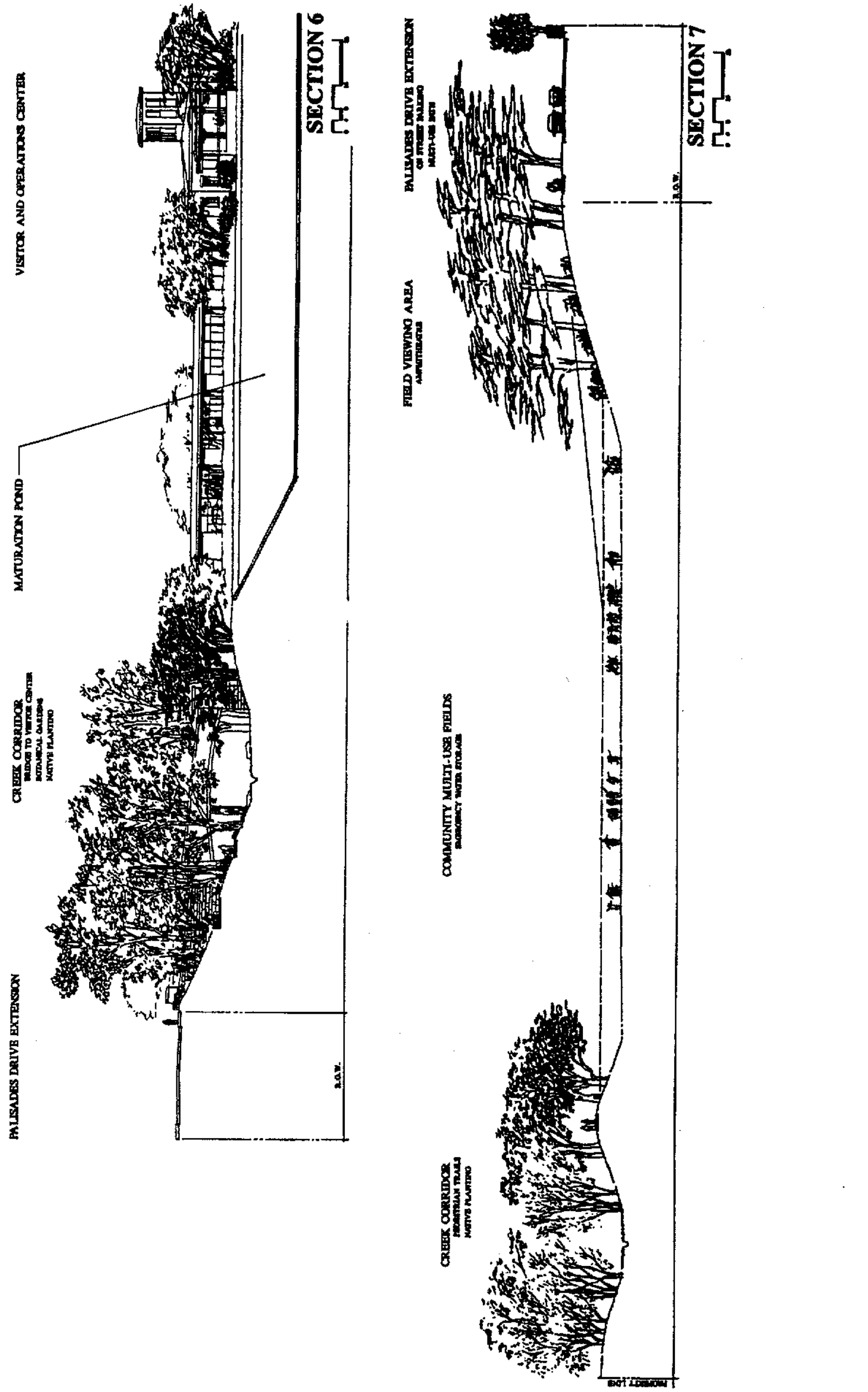
DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-9**



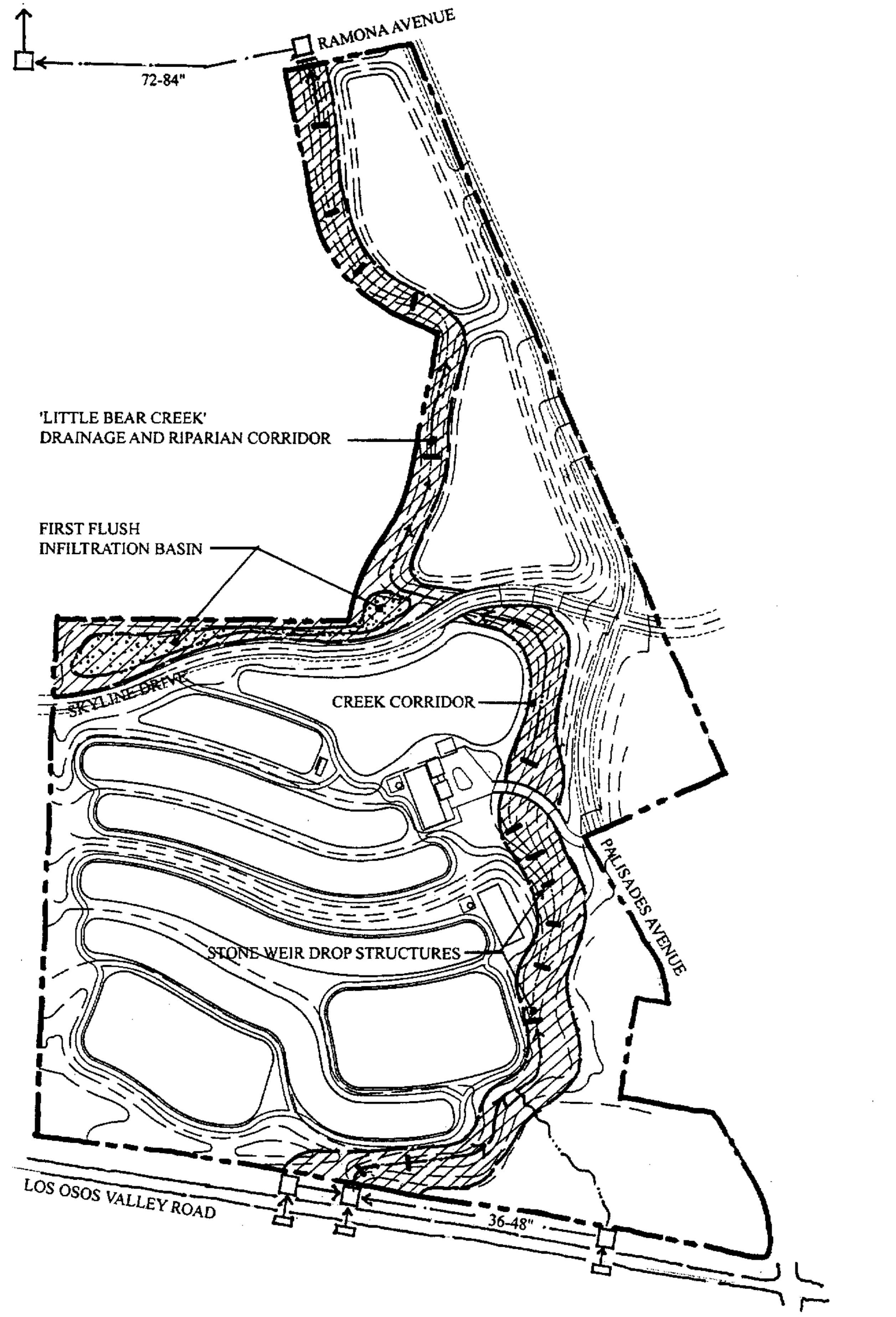
DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-10**



DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-11**



DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	RESOURCE PARK SITE SECTIONS	DESIGN: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-12**



DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	STORM DRAIN SYSTEM	SOURCE: SWA GROUP DATE: JAN. 31, 2000	FIGURE **1-13**

AIWPS® Facility design that will provide emergency disinfection, on-site storage, and, if needed, onsite disposal by percolation of first disinfected tertiary effluent followed by disinfected secondary effluent should the tertiary facilities be offline more than 14 consecutive days. There is, of course, additional internal storage capacity in the primary and secondary ponds in addition to the 14-day storage capacity of the Maturation Ponds at full flow. The disinfected tertiary effluent that is normally stored in the Maturation Ponds (MPs) prior to being pumped to disposal through the gravity well field would, in an emergency, be discharged into the Resource Park athletic fields/emergency storage basins. This final disinfected tertiary effluent would percolate through the bottom of the unlined storage basins thereby allowing the disinfected secondary effluent to be stored in the MPs. After normal operation of the tertiary plant is restored, this water could be subjected to final tertiary treatment and disposal. Assuming that the tertiary treatment elements, each designed to have between 50% and 150% redundancy at full flow, are not out of operation for more than 21 days (MPs plus 1 foot of freeboard storage), a situation which is unlikely, the Resource Park athletic fields/emergency storage basins would never receive secondary disinfected effluent. However, they could be used for this purpose in the event of a prolonged emergency and they have been designed for this dual function.

The wastewater facilities will also include two buildings: one that will serve as the operations office including collection, treatment, and disposal facilities instrumentation and supervisoral control and data acquisition (SCADA) system control center, a water quality laboratory, and a reception/information visitors area; the second building will provide equipment storage space and a maintenance shop.

The wastewater disposal facilities shown in Figure 1-14 consist of two contiguous MPs for final effluent storage; an effluent pumping station; a forced main from the effluent pumping

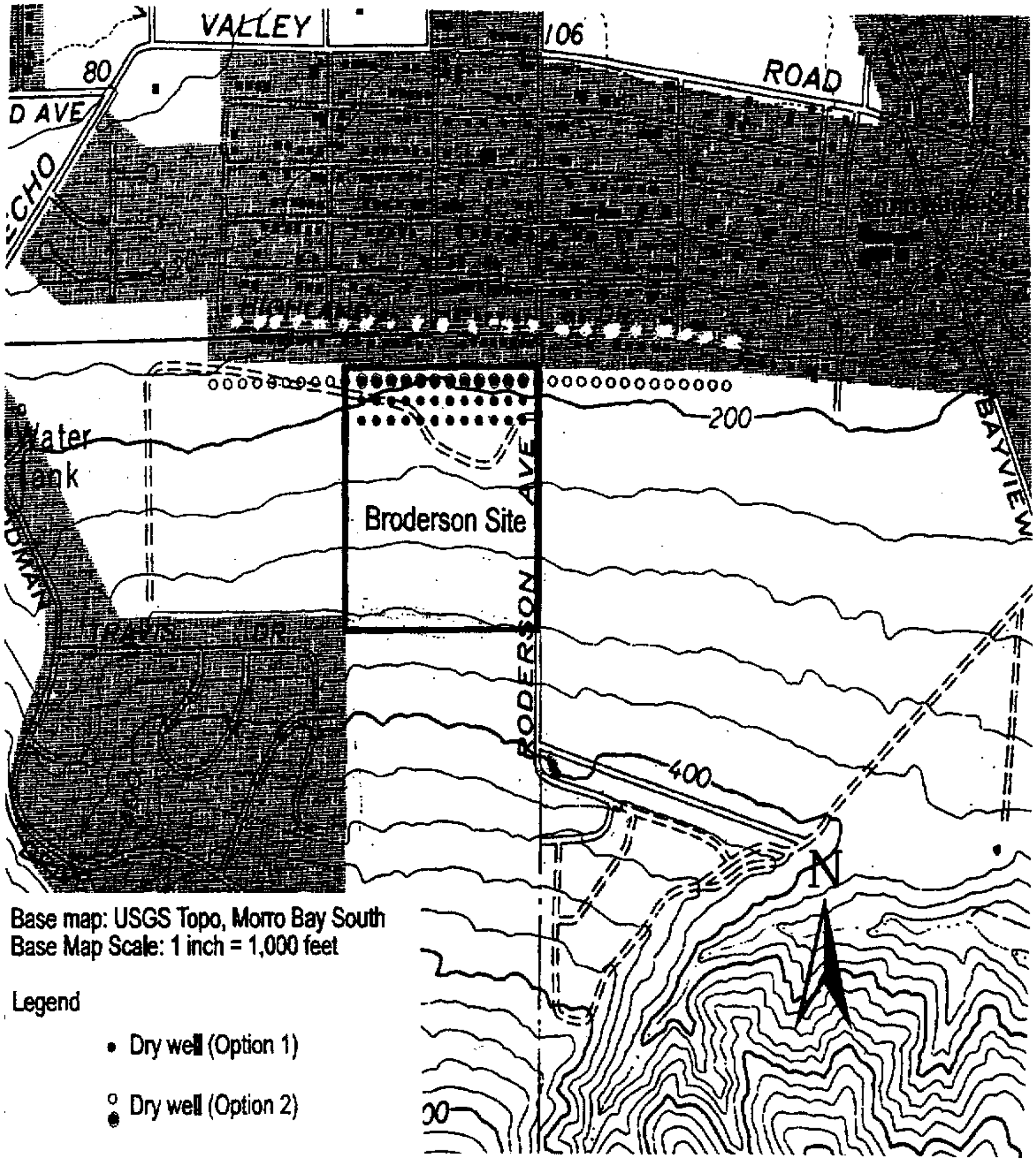


Figure 1.14. Disposal Dry Well Field Layout for the Broderson and Morro Palisades Sites (Source: Cleath and Associates).

station to the disposal area; and, an array of 36 gravity wells controlled and managed to permit the safe and sustainable subsurface disposal of the disinfected tertiary effluent produced in the AIWPS® Facility.

To assist in the planning and preliminary design and implementation of the Wastewater Project, the Los Osos CSD has assembled a team of professional consultants. The list of Wastewater Project consultants and their respective responsibilities includes: (1) Montgomery Watson, Project Manager; (2) Oswald Engineering Associates, Inc., Design Engineer (Oswald Engineering's Design Team includes STEP/STEG expert, W. C. Bowne and four subconsultants: (3) SWA Group, Landscape Architect; (4) Navigant Consulting, Inc.(formerly Bookman Edmonston Engineering, Inc.) Civil Engineer and Water Resource Planner; (5) Gary Grimm, Environmental Legal Counsel; and (6) Granite Construction, General Civil Engineering Contractor; (7) Crawford Clark Multari & Mohr, Environmental Consultant; (8) CFS Geotechnical Consultants, Inc., Geotechnical Engineer; (9) Cleath & Associates, Hydrogeologist; (10) Cannon Associates, Surveyor; (11) John L. Wallace & Associates, Assessment District Engineer; (12) Prager, McCarthy & Sealy, Inc., Financial Consultant; (13) Orick, Herrington & Sutcliffe, Bond Counsel; and other Wastewater Project consultants, as they are needed. Further details of the selected wastewater facilities are presented in Section 8 and Section 10.

PROJECT NEEDS

Los Osos needs to have a state-approved wastewater collection, treatment, and disposal system which is: affordable; has the capacity for the 20-year buildout population in year 2020; has the necessary fundamental biological processes to mitigate total nitrogen discharges; and, has sufficient redundancy to meet routine maintenance and unexpected emergency conditions such as power and equipment failures and equipment shut-downs for routine maintenance.

The community of Los Osos, located on the central coast of California and on the south-eastern edge of Morro Bay halfway between two metropolitan areas, approximately 220 miles south of San Francisco and 230 miles north of Los Angeles. The community of Los Osos is currently populated by young families and by many retired or semi-retired professionals including scientists, engineers, architects, military service personnel, and contractors. There are many businesses and artistic entrepreneurs in the community. Because the community is located primarily on ancient sand dunes somewhat consolidated by erosion and soil depositions from the hills to the east, the sanitation needs of its residential dwelling units and commercial establishments have been served by septic tanks and leach fields or seepage pits. Following federal and state legislation on water quality preservation, nitrate (NO_3^-) concentrations were discovered in the shallow groundwater that were near or in excess of the maximum contaminant levels (MCLs) for drinking water. These observations and measurements resulted in recommendations and Basin Plan amendments as set forth in Resolution 83-13 and subsequent regulatory orders issued by the RWQCB directing the County of San Luis Obispo with responsibility for County Service Area 9 (CSA 9) to mitigate the levels of nitrate found in the shallow aquifer at Los Osos. Four cease and desist orders are currently outstanding for certain segments of the Prohibition Area.

Because nitrate is one of the most soluble anions, its removal from water requires special techniques. Among these techniques are reverse osmosis and reduction to nitrogen gas. Biological uptake of nitrate's precursor, ammonium (NH_4^+), is a remedial method. Another technique is to prevent nitrate formation resulting from oxidation of ammonium to nitrite (NO_2^-) and then to nitrate (NO_3^-). Finally, the precursor gas, ammonia (NH_3), which is converted from NH_4^+ to NH_3 at high pH can be outgassed at normal temperatures.

In 1991, the San Luis Obispo County Board of Supervisors authorized Black &Veatch Waste Science Technology in collaboration with an appointed Technical Advisory Committee (TAC) to conduct an investigation of soil and groundwater nitrogen at Los Osos. The field work was completed in 1993 and a draft report was prepared by B&V consultant Dr. Rajeev Dwivedi (B&V, 1993). A final report expanded from the draft report was prepared in 1994 by members of the Technical Advisory Committee (TAC, 1994). The Baywood Los Osos Soil and Groundwater Nitrogen Study was designed to evaluate the "transport and transformation of nitrogen effluent passing through the soils beneath selected on-site wastewater treatment and disposal systems located throughout the Los Osos groundwater basin." The study based on sample stations below leach trenches and pits provided evidence that in the unsaturated zones beneath the subject septic tanks leach fields, ammonium was oxidized to nitrate and subsequently nitrate was denitrified. In the three sites studied, 13th Street, 14th Street, and Bayridge Estates, nitrate reached a peak level from 10 feet to 20 feet below the leach field depth and then decreased at greater depths to concentrations less than the concentration in the local groundwater.

In 1993 the County of San Luis Obispo Engineering Department retained Metcalf & Eddy (M&E) to prepare a sanitary survey and nitrate source study. In this study, M&E questioned many of the conclusions reached by the TAC, the Blue Ribbon Committee, and the B &V Waste Science and Technology Corporation. Their most convincing evidence was a plot of population versus nitrate in shallow wells showing that they increased in parallel. Although they did not accept the TAC report, Metcalf and Eddy provided space in their report for a detailed review by the TAC of their conclusions. In spite of the TAC's critical review, Metcalf and Eddy concluded that "existing on-site wastewater systems cannot be justified."

Metcalf and Eddy further recommended that Task G- Evaluation of Alternative Technologies be undertaken to develop the best available methods for managing wastewater in Los Osos. Both the TAC Soil and Groundwater Nitrogen Study and the M&E Task F Study were rigorous, but neither attempted correlations with seasonal rainfall during periods of excess rainfall and drought. Doing so could have shed additional light on the dramatic variation in nitrate concentrations found by Metcalf &Eddy and others. It is, of course, difficult to imagine that Los Osos could continue indefinitely to use leach fields in high groundwater areas with no impairment of water quality in the shallow aquifer. modified from original wording added

Because of the particular need to mitigate nitrate concentration in groundwater and thus to comply with Regional Water Quality Control Board requirements, Metcalf and Eddy in their 1995 report chose modified sequencing batch reactors as the best available technology. Metcalf and Eddy did not choose to examine the Advanced Integrated Wastewater Pond Systems (AIWPS®) Technology other than eliminating it on the basis of cost using land area projections for treating the raw sewage of a then-assumed maximum potential population of 28,000 using conventional collection (SOA, 1992). Stemming partly from the TAC study and the Los Osos Community Advisory Council's *Vision Statement* which emphasized natural systems for wastewater treatment and the use the existing septic tanks (representing more than $14,000,000 in infrastructure investment), the Los Osos CSD chose to examine the use a STEG/STEP system for dwelling units within the Prohibition Zone and the AIWPS® Technology as the best, most practicable wastewater technologies for Los Osos. The Los Osos CSD further concluded that the Resource Park was the preferred site for the AIWPS® Wastewater Treatment and Water Purification Facility because of its nearly central location in the Los Osos community and because of the opportunity to provide scenic beauty along with odor-free, effective wastewater treatment within easy walking distance of almost the entire community. The proximity of the Resource Park minimizes collection piping, internal piping, and the disposal piping as well. Because of the evident strong public support for the Wastewater Project, the community of Los Osos and the Los Osos Community Services District have an opportunity to work with the Regional Water Quality Control Board and the State Water Resources Control Board, the California Coastal Commission, and the County of San Luis Obispo to achieve the best, most practicable, and cost-effective wastewater solution and to bring closure to the long standing issues and controversies regarding groundwater quality, water conservation, wastewater management, and future growth.

PROJECT BENEFITS

The project benefits include: the development of a technically feasible, affordable, and environmentally-sound Wastewater Project and management program that will improve and protect water quality in the groundwater basin; protect and safeguard public and environmental health; meet federal and state water quality and environmental requirements including those of the Regional Water Quality Control Board, the State Water Resources Control Board, the California Coastal Commission, and the County of San Luis Obispo; and, provide above-site drainage, park land, recreational open space, aesthetic, and habitat amenities for the community. We will explore in greater detail the first of these benefits.

WATER QUALITY IMPROVEMENT IN THE SHALLOW AQUIFER

One predictable benefit of the Wastewater Project is the enhancement of water quality in the shallow aquifer. The question has been raised as to the time frame in which water quality in shallow aquifer would be improved to useable quality by the Wastewater Project. Based on recent data of well water quality for the three companies that provide drinking water in Los Osos and their production weighted average shown in Table 1-1, and based on the geology of the Los Osos groundwater basin shown in Figures 1-15, 1-16, 1-17, 1-18, groundwater quality, even in the upper portion of the Paso Robles formation, appears to be well within quality parameters that can be regarded as good. Accordingly, the aquifer that is presumably being contaminated and therefore the one to be remediated by the current Los Osos Wastewater Project, is described by Brown & Caldwell (1983) and again by The Morro Group (1986) as the "upper aquifer" or the "shallow aquifer".

Table 1-1. Annual average water quality in commercial drinking water wells supplying Los Osos/Baywood Park and the predicted composite concentrations supplying septic tanks. (ND=nondeductible concentration; — = not measured).

Parameter	LOCSD[1] (CSA 9)	California Cities Water Co.[2]	S&T Mutual Water Co.[3]
Alkalinity as $CaCO_3$ (ppm)	200	---	140
Aluminum (ppb)	5	ND	ND
Barium (ppb)	82	20	0.24
Calcium (ppm)	31.5	24.7	180
Chloride (ppm)	41.1	65.80	1,100
Chromium (ppb)	8	---	ND
Conductivity (μmhos/cm)	506	---	2,500
Copper (90%ile ppb)	1,400	---	ND
Fluoride (ppm)	0.14	ND	ND
Iron (ppb)	33	---	ND
Lead (95%ile ppb)	3.5	---	ND
Magnesium (ppm)	29	19.7	160
Manganese (ppb)	17	---	ND
Nickel	2	---	ND
Nitrate+nitrite as N (ppm)	1.3	4.1	2.8
pH	7.44	7.8	7.0
Sodium (ppm)	35.9	34.8	180
Sulfate (ppm)	21	12.2	63
Total coliform	ND	ND	---
Total dissolved solids (ppm)	295	261	1,800
Total hardness as $CaCO_3$ (ppm)	197	135	1,100
Turbidity (NTU)	0.19	0.43	0.1
Zinc	50	---	ND

[1] Baywood Park Annual Water Quality Report 1998.
[2] Cal Cities Water Company.
[3] Creek Environmental Laboratories, Inc. analyses of March 16, 1999 sample.

The shallow aquifer is separated from a deeper or lower aquifer by a confining zone made up of more consolidated material such as clay. The geology of this area remains to be exactly defined, although it has been characterized in general by the U.S. Geological Survey and by the Department of Water Resources as referenced in the Draft Environmental Impact Report, prepared by The Morro Group for the County of San Luis Obispo (The Morro Group, Vol. II, Appendix C-3, 1986). The greatest concern with nitrate discharges and their mitigation must, therefore, be directed toward the shallow aquifer. According to The Morro Group (1987) in its evaluation of Engineering Science's proposal for conventional sewage collection.

> The general configuration of shallow groundwater levels and their changes over time strongly suggest that the shallow aquifer is recharged by the infiltration of rainfall, septic tank effluent and excess landscape irrigation. Infiltration of rainfall is a long term natural effect, and shallow water levels of the early '60s probably best reflect the levels that can be sustained by this source. Sewering of the community would eliminate septic tank effluent as a contributing source of shallow recharge, but excess landscape irrigation would continue to add to natural recharge. Based on the Brown and Caldwell hydrologic equation reproduced herein as Table 1-2, irrigation return water constitutes approximately 43% of the urban sources of shallow recharge. Assuming that this source of recharge would continue, the reduction in recharge of the shallow aquifer with sewering of the community would be approximately 57% of the rise that has occurred with on-site sewage disposal."

The surface of the "confining beds" that separate the shallow aquifer from the Paso Robles strata is cup-shaped and slopes downward to the west with an approximate slope of 1%. Because of this slope and the fact that lateral percolation through sand is said to be from 10-times up to 100-times the vertical percolation (due to many small intermediate impermeable based on pattern when supply came from shallow GW

Table 1-2. Hydrologic Equation for the Los Osos Groundwater Basin, 1972 and 1980 Conditions.

Item	1972 (a)	1980
INFLOW:		
Infiltration of Precipitation and Infiltration of Runoff	3100	3100 (b)
Agricultural Irrigation Return Water	470	590 (c)
Urban Irrigation Return Water	230	500 (d)
Return Sewage	300	650 (d)
Total INFLOW (g)	4100	4840
OUTFLOW:		
Pumpage for Agricultural Irrigation Use	1100	1070 (e)
Pumpage for Urban Use	920	1990 (f)
Subsurface Outflow	2080	1780
Total OUTFLOW (g)	4100	4840

a) Brown and Caldwell 1974 Report, "Preliminary Groundwater Basin Management Study", Page 17.

b) Department of Water Resources 1973 Report "Los Osos - Baywood Ground Water Protection Study," p. 23.

c) Calculated as difference between applied water and evapotranspiration figures from County prepared tables.

d) Brown and Caldwell (1983).

e) Brown and Caldwell (1983), Volume II, Appendix III, Table III-6.

f) Based upon Unit Urban Water Use factor and 1980 population (Brown and Caldwell, 1983, Volume II, Appendix III).

g) Assuming no change in storage, total inflow equals total outflow.

lenses, interspersed in the compacted dune sand) water introduced to the shallow aquifer should move to the west with limited retention as indicated by measurements of the depth to groundwater from the surface (Figure 1-5 and Figure 1-6).

Incorrect: RB asked for explanation of what was "ambiguous" about Questa Report.

Regional Water Quality Control Board staff have requested an explanation of the differences between the Oswald Engineering Associates assumptions and those of Questa Engineering Corporation. Questa concluded that 23 years would be required to reach 7 mg/L. Also it has been suggested that the assumptions used in the Questa (1998) model be carefully evaluated. In fact the Questa model is identical to that of OEA in the assumption that the length of time required to bring the concentration of nitrogen in the entire upper aquifer into compliance with the Basin Plan is dependent on the rate of change of N concentration in the aquifer due to the introduction of low N concentration water to the aquifer. Missing in both models is the important and indeterminate factor of mixing. Mixing aside, the rate of change of ground water N is mainly a function of the volume and N concentration of the receiving aquifer and the volume and N concentration of the water entering the receiving aquifer.

Questa Engineering Corporation, Inc. (1998) prepared a simple model for the Los Osos groundwater basin which predicted nitrate groundwater concentrations over 50 years under the conditions of the proposed County Wastewater Project based on a constant population of 18,000 PE (Phase 1 population) and under the conditions of the proposed Community Wastewater Project. The model predicted a drop in overall groundwater nitrate concentrations due to wastewater collection and treatment and due to dilution of the groundwater by infiltration of rainfall and treatment plant effluent disposal.

OEA has developed its own values for the model and applied them to the proposed Los Osos CSD Wastewater Project. The results are compared to the predicted results of the County

Project in the Questa model as shown in Figure 1-20. The assumptions used by Questa are compared to those of OEA in the following paragraphs.

The upper aquifer depth was assumed by Questa to average 100 ft with a soil porosity of 0.2. The aquifer boundaries were the Prohibition Line and Strand B of the Los Osos fault which divided the aquifer into a northeast sub-basin holding 25,000 AF and a southwest sub-basin holding 16,000 AF.

Oswald Engineering used cross sectional drawings of the groundwater basin geology prepared by The Morro Group and reproduced as Figures 1-16 and 1-17 (1986); a contour map of the floor of the shallow aquifer (top of the aquitard) prepared by The Morro Group reproduced as Figure 1-18 (1998), and a soil porosity of 0.3 (Lindeburg, 1992). Oswald Engineering estimated the volume of water in the northeast sub-basin to be 31,000 AF and in the southwest sub-basin to be 14,000 AF.

Concerning the existing groundwater nitrate concentration, Questa Engineering assumed 13.0 mg/L as N which is the average of values in County's Baywood Groundwater Study-First Quarter 1998; whereas, Oswald Engineering used average of values from the County's Baywood Groundwater Study-Fourth Quarter 1998. Oswald Engineering used 9.6 mg/L as N for the northeast sub-basin and 22.3 mg/L as N for the southwest sub-basin.

Concerning wastewater disposal flow, Ouesta Engineering assumed that 1.32 MGD would be recharged to the southwest sub-basin under the County Project; 1.32 MGD was the proposed Phase 1 treatment plant capacity. No recharge for the northeast sub-basin was proposed. The flow of 1.32 MGD was the collected portion of the total wastewater flow of 1.59 MGD in sewers and septic tanks for a population of 18,000 PE. At predicted full build-out, the County Plan required 2.0 MGD of treatment capacity. Build-out flows were not considered in the Questa model. Oswald Engineering assumed that 90% of the 1.0 MGD maximum buildout flow generated by 14,500 PE who would be collected would be disposed by gravity wells recharging the southwest sub-basin.

Concerning the total nitrogen concentration in the treated wastewater, Questa Engineering assumed 7.0 mg/L as N as was expected by Metcalf & Eddy and the County of the Modified Ludzack-Ettinger treatment process. Oswald Engineering assumed 6.0 mg/L as N as the expected effluent N concentration that would be produced by the proposed AIWPS® Facility.

Concerning the average annual septic tank leachate flow and its nitrogen concentration, Questa Engineering acknowledged that some areas were not collected in the County Project leaving a recharge flow of 100 AF/year in the southwest sub-basin and 202 AF/year in the northeast sub-basin. Questa assumed total nitrogen concentrations of 57 mg/L in septic tank effluent and 21.0 mg/L entering the groundwater with the leachate after 63% total nitrogen removal primarily due to denitrification in the soil column. These concentrations are based on measurements from two septic tanks in the Los Osos/Baywood Park Nitrogen Study (1994). However, the septic tank effluent total N concentration of 57 mg/L is much higher than the average of 38 mg/L found in measurements from septic tanks made thoughout Los Osos by Brown and Caldwell (1983). Oswald Engineering using detailed existing DUE counts and predicted DUEs at full buildout, estimated the population in the uncollected areas of the Prohibition Zone as follows:

Northeast sub-basin

Northeast Baywood Park

Uncollected and >30' to groundwater 903 PE

Uncollected and <30' to groundwater	0 PE
Central Baywood Park	
Uncollected and >30' to groundwater	700 PE
Uncollected and <30' to groundwater	892 PE

Southwest sub-basin

Bay Oaks, all >30' to groundwater	213 PE
Martin Tract, all >30' to groundwater	185 PE
Sunset Terrace, 75% >30' to groundwater	164 PE
Sunset Terrace, 25% <30' to groundwater	106 PE

A septic tank effluent flow of 49 gallons per PE per day is the expected flow for the above uncollected septic tank as explained in Section 6 and Section 8. For total nitrogen, the average value of 38 mg/L of Brown and Caldwell (1983) was used because of the wider cross section of the community included in their sampling versus the concentrations from two septic tanks quoted by Questa from the Los Osos/Baywood Park Nitrogen Study (1994). Where groundwater was greater than 30 feet below the surface, the total nitrogen concentration entering the groundwater with leachate was assumed to be 21.0 mg/L. This concentration is the same concentration used by Questa Engineering, but it represents a 50% reduction in total nitrogen due to denitrification rather than the 63% used by Questa. Where groundwater is less than 30 feet below the surface, Oswald Engineering assumed 25% nitrogen removal to 28.5 mg/L before the leachate would enter the groundwater.

Concerning rainfall infiltration and irrigation seepage, Questa Engineering and Oswald Engineering assumed infiltration due to precipitation to be 12 inches per year which was the annual rainfall average of 19 inches per year reduced by runoff (1-2 inches) and evapotranspiration (5-6 inches). Rain and irrigation seepage were estimated to contain 3.6 mg/L of nitrogen from fertilizers, animal wastes, natural sources, soil disturbance, and weed abatement.

Figure 1-19 portrays the results of these assumptions. As portrayed, the southwest sub-basin will reach 10 mg/L as N in about 10 years, 7 mg/L in 17 years, and 5.2 mg/L in 41 years. In the case of the northwest sub-basin, although average nitrate today is 9.8 mg/L as N due to the fact that no recharge will be made in that sub-basin, it will require 21 years to reach 7 mg/L and 50 years to reach 5.8 mg/L unless some low nitrate water is introduced.

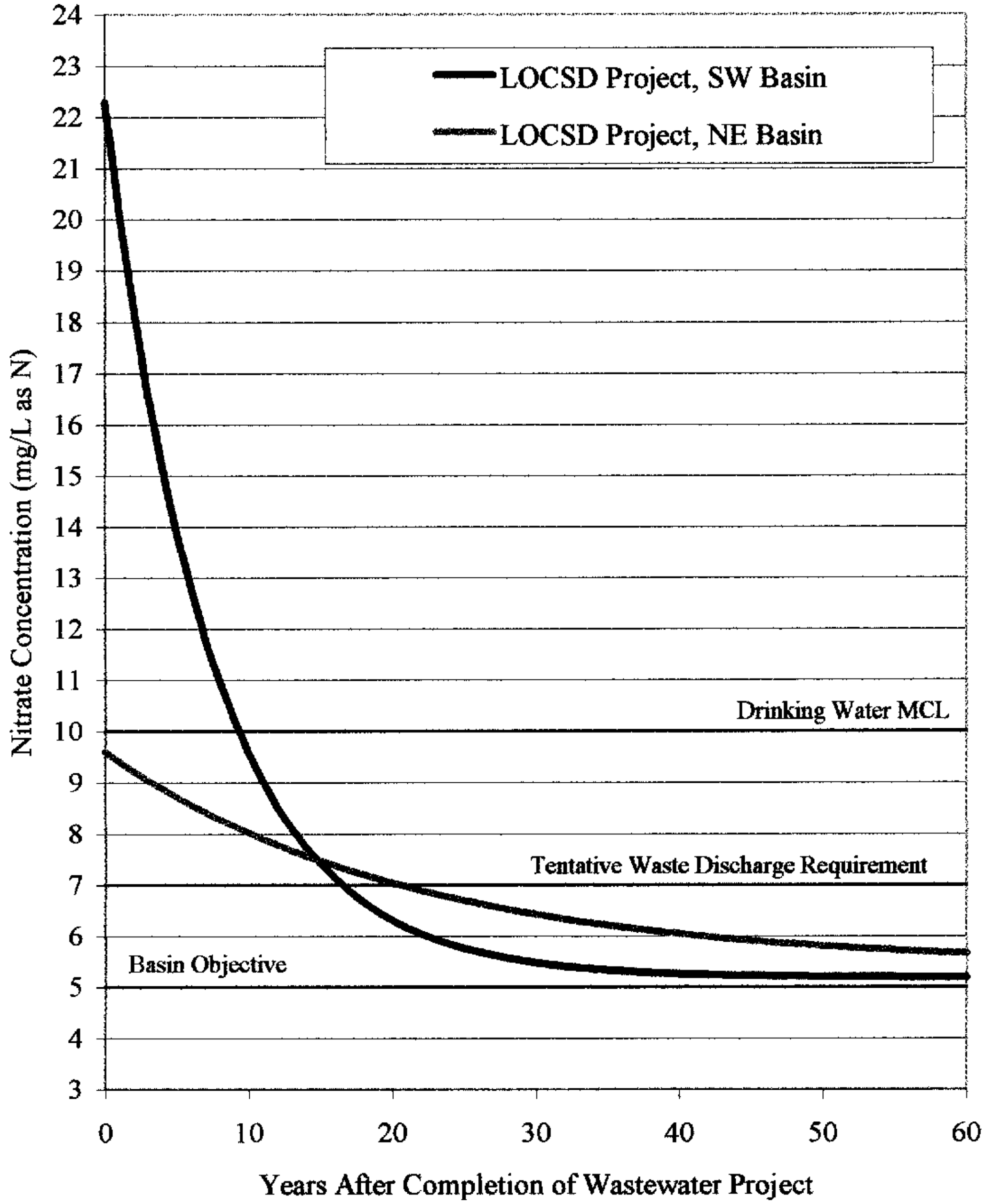


Figure 1-19. Nitrate-N concentrations predicted for Los Osos groundwater with the Los Osos CSD Wastewater Project.

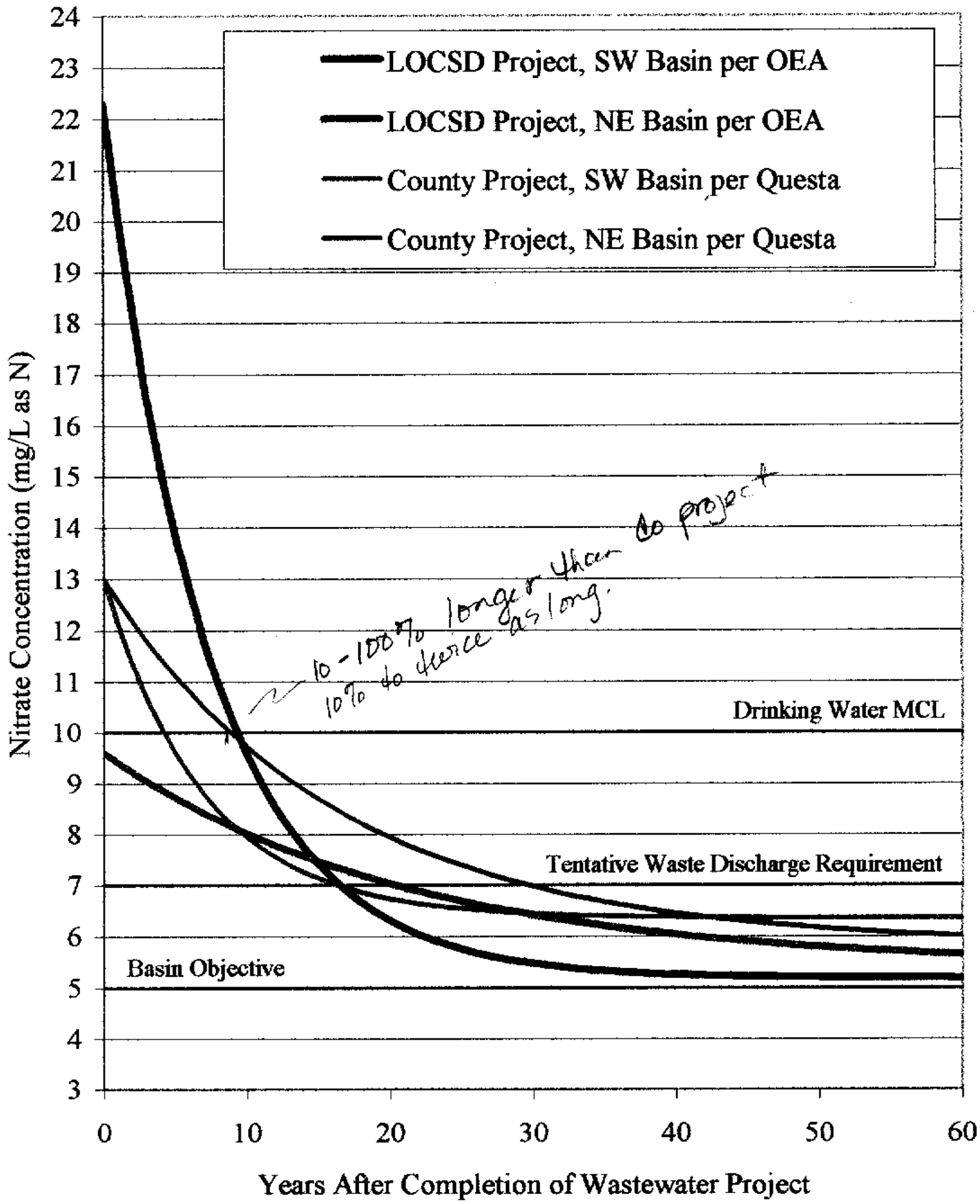


Figure 1-20. Nitrate-N concentrations predicted for Los Osos groundwater with the Wastewater Projects proposed by the Los Osos CSD and the County.

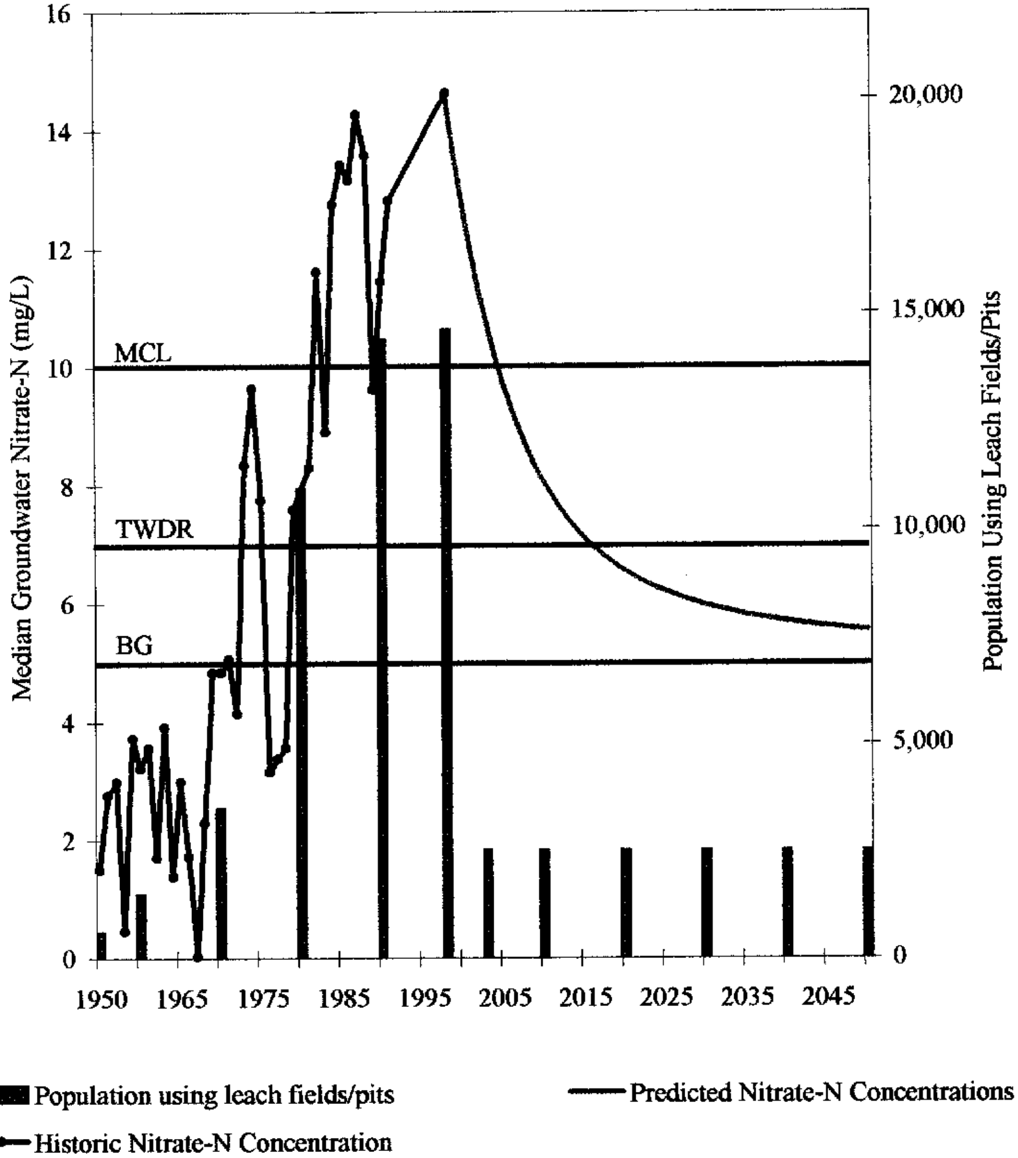


Figure 1-21. Increase in median groundwater nitrate concentration and its projected decrease with the proposed Los Osos CSD Wastewater Project. The population values shown are those served by leach fields/pits. MCL is the Maximum Contaminant Level; TWDR is the Tentative Waste Discharge Requirement; BG is the Basin Goal.

Individual parcel fees were in the range of $50.00 per month after an initial individual dwelling connection fee of as much as $600. These estimated monthly sewer costs aroused community apprehensions because they were clearly beyond the means of many young families and many retired residents. There was an idea that gained support among concerned residents that lower wastewater costs might result from a system in which most of the septic tanks were retained for the purposes of providing primary treatment while the septic tank effluent would be collected using a Septic Tank Effluent Pumping (STEP) collection system that relies upon grinder pumps located within each collected septic tank and shallowly buried, small diameter pipes that would convey the collected septic tank effluent to a local wastewater treatment facility where nitrate and other pollutants could be removed prior to its disinfection and disposal into groundwater by way of percolation ponds. To study these and other alternatives, the firm of Engineering Science was retained by the County Engineering Department to prepare a Phase I Sewerage Planning Study for CSA 9. The study was done in conjunction with local environmental consultant, the Morro Group, who was also retained by the County to prepare the environmental documentation and preliminary environmental impact reports for the alternative wastewater projects evaluated by Engineering Science (1986).

The Engineering Science study was divided into two phases: planning and design. The authors of the Phase 1 Report, published in May of 1986, examined four methods of sewage collection: gravity sewers; variable grade gravity sewers; pressure sewers, including grinder pump systems and septic tank effluent pumping (STEP); and, combinations of the previous three methods. The three methods of wastewater and septic tank effluent treatment included: continuous loop oxidation ditches (extended aeration); sequencing batch reactors (SBR); and physical-chemical (PC). The five methods of wastewater disposal included: wet weather disposal to Los Osos Creek; dry weather disposal to Los Osos Creek; percolation ponds;

landscape irrigation; and agricultural irrigation. From an engineering standpoint, the Engineering Science analysis was thorough and comprehensive, with rational development of each alternative prior to cost estimation. The cost information is reviewed here for comparative purposes later in this report. The Engineering Science estimate for gravity sewers, taking into consideration construction difficulties in sand and high ground water, was $24,600.000 ($24.6M). With operations and maintenance (O&M) estimated at $165,000 per year, they estimated the present worth (PW) at $24.4 mm. The Engineering Science estimate for pressure sewers ranged from $16.3M for one pumping unit per two users to $23.5M for one unit per user. By assuming that each system would have annual operations and maintenance (O &M) costs of $270,000, Engineering Science then estimated the net present worth of each option to be $19.5M and $27.7M , respectively. Although the one pump unit per two users was clearly least cost, Engineering Science pointed out the potential conflict of dual responsibility for power costs and pump maintenance. The Engineering Science estimate for variable grade sewers was tentatively set at $22M, with the caveat that it was a new concept with little background information and no PW was estimated. The ES estimate for a combination system was $ 21.9M with O&M at $200,000 per year and the present worth was estimated at $23.5M.

Considering the three modes of treatment, the extended aeration treatment option was estimated to cost $7.9M with a present worth of $10.7 M. The sequencing batch reactor was estimated at $7.5M with a present worth at $10.4 M, and the PC estimate was $10.6M with a present worth (PW) of $29.3M due to the high O&M for chemicals and labor. For disposal Engineering Science estimated pipeline costs, depending on treatment plant location, to be in the range of $1.6M to $2.1M and, including pumping energy and O &M, PWs of $2.3 M to $2.9 M respectively.

Because of lack of detailed information on the often recommended Broderson disposal site, no cost estimate was made for disposal wells. Infiltration ponds for disposal were estimated to cost \$1.7M with monitoring systems at \$0.005M yielding a present worth of about \$3.2M. The total least cost present worth for single unit STEP collection, sequencing batch reactor treatment, transmission/disposal in percolation ponds is 39.4M. ES estimated a slightly lower cost for dry weather disposal into Los Osos Creek, not likely to be accepted by the Regional Board. It should be noted that all of the Engineering Science costs are in 1985 dollars when the ENR CC I was 5180 compared with the January 1984 ENR CCI of 5050 used by Brown & Caldwell and the December 1999 index of 6127 that Oswald Engineering Associates will use.

Following the Engineering Science study there ensued several periods of litigation not reviewed herein. In a letter dated Dec. 31, 1991, Mr. Gibson of the County of San Luis Obispo Engineering Department requested that W.J. Oswald prepare a description of an AIWPS® Facility served by conventional gravity sewers and designed for a build out population of 28,000 people. In a brief report dated February 1992, Oswald's previous firm Swanson Oswald Associates, Inc. described two alternatives: an Advanced Integrated Ponding System (AIPS) Types 1 and an AIPS Type 2. The proposed AIPS Type 1 Process was to be aerated mainly by photosynthesis and the AIPS Type 2 Process was to be aerated primarily by mechanical aeration. Swanson Oswald Associates, Inc. estimated that the AIPS Type 1 Facility could reach effluent nitrate concentrations of 5 mg/l and that the AIPS Type 2 Facility could reach effluent nitrate concentrations of 6 mg/l. The AIPS Type 1 Facility was estimated to require 37.5 acres with a first cost of \$3.43M, and the AIPS Type 2 Facility was estimated to require 26 acres and to cost \$2.81M.. Land costs were excluded in both cases. It should be emphasized that these costs related to treating raw sewage from 28,000 persons rather than septic tank effluent from approximately 14,000 persons.

In 1994, the County Engineering Department moved to complete the wastewater planning by funding a further study made by the west coast office of Metcalf & Eddy. Metcalf & Eddy in their July 1995 report entitled *Los Osos Wastewater Study; Task G-Report: A Detailed Evaluation of Alternatives* rejected the above described Advanced Integrated Ponds Systems on the basis that their present worth cost would be $7.06M as compared with a "Modified Ludzack Ettinger (MLE) Sequencing Batch Reactor (SBR)" system cost of $3.4M. The major cost difference was obviously the amount of land which Metcalf & Eddy estimated for ponds: 45 to 50 acres. It was not clear that the Metcalf & Eddy study had used a population of 28,000 for the MLE SBR System. No Metcalf & Eddy estimates were made for STEP/STEG collection or treatment.

By this time, concerned citizens of Los Osos had already rejected the Metcalf & Eddy and County Engineering Department proposal and began preparation of an alternative, conceptual wastewater facilities plan known as the Comprehensive Resource Management Plan that involved a STEP/STEG collection system combined with an Advanced Integrated Wastewater Pond System or AIWPS® Facility for advanced, tertiary wastewater treatment and water purification combined with wastewater disposal facilities that would keep the treated wastewater effluent within the groundwater basin upon which the community depends for its drinking water supply.

Part of the reason for rejecting conventional gravity sewers was cost, because experienced community citizens anticipated huge cost overruns for excavation, placing and bedding standard depth gravity sewers in this sandy location which would most likely require side shoring for almost the entire length of the collection system. Other difficulties resulting from high groundwater were also anticipated. Also the extensive infiltration and inflow (I&I)

projected for gravity sewers would require the capacity of a short residence time, mechanical wastewater treatment process to be up to 4 times as large as actually needed under average flow conditions and hence would be larger and more expensive to build and to operate. In nitrification-denitrification processes such as the one proposed by Metcalf & Eddy, a supplementary nitrate removal stage should be designed into the system in case it is required to meet more stringent effluent nitrate standards. In a world where the cost of energy is increasing and increasing energy consumption is contributing to the increase in greenhouse gases (GhG) emissions, nitrification-denitrification processes require twice as much energy as do conventional mechanical secondary treatment processes and up to 10 times as much energy as is required by an equivalent capacity AIWPS® Facility. There are further concerns with increased TDS due to proposed chlorine disinfection, required to protect the shallow groundwater from enteric bacteria. Chlorine in the required concentrations would add to the dissolved solids increment in the treated water thereby diminishing its value as irrigation water for NaCl-sensitive plants. Moreover, the alternative of Ultraviolet (UV) light disinfection would require final filtration of the MLE/SBR effluent.

The costs of effluent filtration and legal sludge disposal under the Federal 503 Biosolids Disposal Regulations were not included in the original Engineering Science, Brown & Caldwell, and Metcalf & Eddy cost estimations. These factors led to the community belief that cost overruns for conventional wastewater collection, treatment, and disposal could lead to individual dwelling unit assessments in excess of $100 per month. On November 24, 1997, the citizens group known as the Solution Group published their *Los Osos/Baywood Park Comprehensive Resource Management Plan: A Plan By and For the Community* (CRMP). The Solution Group also requested the California Coastal Commission and the RWQCB to provide an independent comparative review of the Metcalf & Eddy proposed wastewater facilities known as the "County Plan" and the wastewater facilities proposed by the Solution

Group in its CRMP known as the "Community Plan". County Engineering selected Questa Engineering Corporation, Inc. based in Point Richmond, California to provide a comprehensive comparative study of the County Plan and the Community Plan. The Questa draft report dated May 21, 1998 and entitled *Comprehensive Comparative Analysis of Alternative Wastewater Treatment Plans For Los Osos San Luis Obispo County California* favored the County Plan, with reasons that indicated a lack of familiarity with the Community Plan and how it would protect groundwater quality to the same or greater extent than claimed in the County Plan. Following a heavily attended California Coastal Commission hearing held in Santa Barbara, California in May 1998 in which the recommendations of the draft Questa report were examined, it was left to the Community leaders to convince the County and the Regional Water Quality Control Board of the soundness of their plan.

Leading up to the elections of November 3,1998, the CRMP signed by 16 community leaders was a significant factor in sustaining community opposition to the County Plan and formation of support for a new project. This led to an 87% approval by the 75% turnout of the registered voters for formation of the Los Osos Community Service District by the communities electorate.

The Los Osos Community Services District (CSD) was formally initiated on January 1, 1999. Governed by a board of five community residents, the Los Osos CSD, based on Oswald Engineering Associates credentials, experience, and ownership of the proprietary natural treatment process known as the Advanced Integrated Wastewater Pond Systems® Technology or AIWPS® Technology, retained Oswald Engineering Associates, Inc. (OEA) to provide wastewater facilities planning and to prepare the Project Reports. Authors of the Project Reports herein present the Wastewater Project and wastewater management program that has been selected by the Los Osos CSD and the required wastewater facilities that will successfully address the wastewater needs of the community, including their public health and water quality benefits, particularly with respect to the mitigation of nitrate and enteric microbial groundwater pollution through hygienic and dependable septic tank effluent and septage collection, treatment, and disposal. It should be noted here that septic tanks or Imhoff tanks followed by ponds for disposal comprised a system that was widely and successfully used throughout the U.S. during the early 20th century and continued until the availability of large amounts of federal funds gave communities and engineering firms an opportunity to have the most expensive systems they could justify. Ponds were downgraded because they could not always meet their effluent suspended solids requirements even though the suspended solids did not originate in the sewage. In the AIWPS® Technology for Los Osos, suspended solids removal is provided in fail-safe systems leaving an effluent with few suspended solids, virtually no BOD, and very little nitrogen.

Table 2-1. Total project cost expressed as Present Worth[1] in 1999 dollars for four wastewater projects proposed for Los Osos.

Engineer Date	Process	Level of Treatment	Phase 1 Cost[2]	Total Buildout Cost ($M)
B&C 1984	Gravity sewer-Oxidation ditch-percolation ponds	Secondary	Serving 28,000 $46.7	Unknown
ES 1986	Gravity sewer-SBR-percolation basins	Tertiary	Serving 28,000 $56.6	Unknown
M&E 1987	Gravity sewer-MLE-gravity wells	Tertiary	Cuesta = 84.2 $93.4	Unknown
OEA 2000	STEG/STEP-AIWPS® Technology-gravity wells	Tertiary	N/A	$70.3[3]

[1] Total cost over 50 years at 4.1% interest per RWQCB Baywood Park/Los Osos Workshop September 7, 1999. Annual O&M costs were converted to present value with the following standard formula: Present Worth = Annual Cost x $[(1+i)^n - 1] \div [i(1+i)^n]$ + Capital Cost.

$84.2 M including house connections. how did it get to $93.4 w/o?

[2] B&C, ES, and M&E Project excluded house connections (valued at $400 to $2000 each by B&C) and septic tank decommissioning. M&E Project excluded sewer trench shoring and dewatering, sludge disposal, and environmental mitigation costs. M&E Project includes general project costs through June 30, 1997 and costs for the following: Assessment District, permits acquisition, financing, property acquisition, rights of way, pump discount, Segment I & II construction, construction management, and environmental monitoring (Assessment District Engineer's Report, June 1997).

[3] OEA estimate includes a 30% contingency, STEG/STEP house connections and retrofits; $0.9 M for two new roads (Skyline & Palisades extensions) and road improvements along Los Osos Valley Road, including curb & gutters, sidewalks and landscaping; $2.9 M for creek and drainage corridor (drainage management system); and, $13.0 M for land and environmental mitigation. OEA Project cost estimate excludes the $4.0 M for Community Park as these are non-project costs.

Table 2-2. Capital and O&M costs expressed in 1999 dollars for four wastewater projects proposed for Los Osos (B&C, ES, M&E Projects costs are Phase I only).

Engineer Date	Process	Capital ($ millions)	Annual O&M ($ millions)
B&C[1] 1984	Gravity sewer-Oxidation ditch-percolation ponds	$36.2[2]	$0.5
ES[1] 1986	Gravity sewer-SBR-percolation basins	$44.6	$0.6
M&E 1987	Gravity sewer-MLE-gravity wells	Cuesta $58.9 $68.1[3]	$1.2
OEA 2000	STEG/STEP-AIWPS®-gravity wells	$51.3[4]	Cuesta est. $1.9 M $0.9

[1] ES and B&C projects updated to 1999 costs (ENR=6127).

[2] B&C, ES, and M&E Projects excluded house connections at $400 to $2000 each and septic tank decommissioning. M&E Project excluded trench shoring and dewatering, sludge disposal, and environmental mitigation costs.

[3] Assessment District Engineer's Report (June 1997) includes general project costs through June 30, 1997 and costs for the following: Assessment District, permits acquisition, financing, property acquisition, rights of way, pump discount, Segment I & II construction, construction management, and environmental monitoring. The figure shown excludes house connections to lateral sewer. not according to Cuesta Report

[4] OEA estimate includes a 30% contingency, STEG/STEP house connections and retrofits; $0.9 M for two new roads (Skyline & Palisades extensions) and road improvements along Los Osos Valley Road, including curb & gutters, sidewalks and landscaping; $2.9 M for creek and drainage corridor (drainage management system); and, $13.0 M for land and environmental mitigation. OEA Project cost estimate excludes the $4.0 M for Community Park as these are non-project costs.

The evaluation of alternative wastewater collection, treatment, and disposal facilities has been an ongoing endeavor of the County of San Luis Obispo Engineering Department and its consultants over the past two decades. Three engineering consultants evaluated a range of alternatives, selected a preferred alternative, and initiated the planning and preliminary design phase for three different wastewater projects. In this section, these three previous wastewater projects are used as the basis for evaluating and comparing the cost effectiveness of the current Los Osos Wastewater Project. Total and itemized capital costs as well as the predicted annual operation and maintenance costs for the current Wastewater Project will be compared with the capital and O&M costs for the three previous wastewater projects. Further historical background will provide the context for this cost effectiveness evaluation.

The community of Los Osos was built on soils consisting mainly of ancient, semi consolidated sand dunes overlain with silt. Because of the sandy soil, the earliest modern residents were able to utilize septic tanks for domestic and light commercial sewage treatment and leach fields for effluent disposal. Also because of its coastal location, Los Osos and the septic systems by which it is served are located within several jurisdictions: that of the California Coastal Commission; the California State Water Resources Control Board and its Regional Water Quality Control Board, Central Coast Region; the State Department of Health Services; and, the County of San Luis Obispo.

The County adopted the septic tank specifications of the 1973 Uniform Plumbing Code, whereas, the California Coastal Commission adapted more than ten specifications for septic systems, including specific conditions for leach field design (two channels to be used on alternate years); separation between leach fields and groundwater of at least five feet; along with eight additional septic tank regulations including a specified minimum septic tank size of 1,000 gallons with specified risers for inspection and certification by a certified septic tank specialist to assure proper tank and leach field maintenance.

Unfortunately septic tanks and disposal systems for some dwelling units in Los Osos were installed long before the Porter Cologne Act, the County's septic system requirements, or the California Coastal Commission's septic system specifications. Many of these earlier septic systems could not, ex post facto, conform with these more recent requirements. For example, some residential lots in Los Osos are so small that septic tank effluent is disposed in deep seepage pits, some of these extending near, or at times, into the shallow groundwater.

These earlier septic tanks and disposal systems have created some contamination of the groundwater and the potential for further contamination of groundwater. Indeed, because of the shallow depth to groundwater in some areas of Los Osos, some septic tanks were built above ground, presumably to avoid inundation or reverse flow as the level of groundwater rises during intense or prolonged storm events. Septic tank effluent disposal that meets sanitary standards is clearly impossible under such difficult physical conditions. These conditions and their continuing potential for groundwater contamination led the Regional Water Quality Control Board, (RWQCB), Central Coast Region, to draft an interim plan in 1971, which was later adapted in 1975 as the Water Quality Control Plan for the Central Coast Basin. (RWQCB, 1975).

The 1975 Central Coast Basin Plan called for elimination of septic tanks in CSA 9 with conventional collection and treatment of the community's sewage. It was in response to this Basin Plan that the County of San Luis Obispo requested the preparation of a groundwater study followed by a feasibility study to prove the need for such a drastic and expensive undertaking. The study initiated in April 1980 was undertaken by Brown & Caldwell, an engineering company known for its expertise in water quality, water resource management, and wastewater treatment. The Brown & Caldwell study was divided it into two phases. Phase I was a study of groundwater quality in CSA 9 (Brown & Caldwell, 1983). Phase II was a facilities planning study to determine the most cost effective viable wastewater facilities alternative to improve water quality in the planning area (Brown & Caldwell, date).

The Phase I Study, conducted in collaboration with the County Health and Engineering Departments, presented a clear picture of the contamination of the shallow groundwater with enteric bacteria and high dissolved solids beneath the most populated areas. Nitrate concentrations in some locations were reported in excess of the recognized maximum contaminant level (MCL) of 45 mg/l as Nitrate (NO_3^-) or 10 mg/l as N. Authors of the Phase I Study concluded that groundwater quality degradation was primarily due to the inadequate septic tank effluent disposal and, secondarily, due to runoff from garden and agricultural irrigation return flows. These results made public in early 1983 resulted in the RWQCB issuing Resolution No. 83-13 which revised and amended the 1975 Basin Plan by the addition of a prohibition of waste discharge from individual sewage disposal systems within a delineated prohibition area within the communities of Los Osos and Baywood Park.

Backed by Resolution, 83-13, Brown & Caldwell in the Phase II Study examined the feasibility of various collection and treatment alternatives ranging from "doing nothing" to sewering and collecting the entire area , treating the sewage locally to remove nitrate, and after chlorine disinfection, returning the treated effluent to the local groundwater through percolation. The latter was selected as the best alternate, and its estimated total cost using Engineering News Record Construction Cost Index (ENR CCI) at about 5260, was $33,524,000 ($33.5M).

SECTION 3
DISPOSAL ALTERNATIVES EVALUATION

INTRODUCTION

This section presents the disposal alternatives evaluation for both the final effluent and for the biosolids that will be produced during the course of wastewater treatment under the current Wastewater Project. The method of effluent disposal that has been selected for the current Wastewater Project is the same method that was selected for the County's wastewater project for Los Osos that was prepared by Metcalf & Eddy and tentatively approved by the Regional Water Quality Control Board pending further hydrogeological investigation of the candidate disposal sites. These same candidate sites are being investigated further as part of the planning and preliminary design of the current Wastewater Project. Alternative locations for the effluent disposal include the northern portion of the Broderson Site; the northern edge of the Morro Palisades site; and in the public right-of-way of Highland Avenue. The disposal alternatives for the wastewater solids produced during the treatment of septic tank effluent and septage under the current Wastewater Project are also discussed in this section.

WASTEWATER DISPOSAL DESIGN OPTIONS AND IMPACT INVESTIGATIONS

Because of the extensive treatment train for septic tank effluent including sedimentation, fermentation, aeration, secondary sedimentation, coagulation, dissolved air flotation, filtration, and disinfection, the water will be of high hygienic quality. The selected method for the disposal of treated wastewater is through irrigation reuse to the extend needed and percolation through an array of gravity wells each capable of accepting 40 gallons per minute (gpm). This latter method was the selected disposal method proposed by Metcalf & Eddy and the County of San Luis Obispo for the previous Los Osos wastewater project. This method was tentatively accepted by the Regional Water Quality Control Board. As noted above, the final effluent from the AIWPS® Facility will have been subjected to primary, secondary, tertiary treatment for nitrogen removal, and final disinfection as is further described in Section 8. Before discussing effluent disposal under normal operating conditions, it is important to understand the emergency bypass capacities of the wastewater facilities and the surrounding Resource Park.

Should one or all of the final tertiary treatment facilities need to be taken off-line for maintenance or in the event of an emergency power outage or mechanical failure, and after the redundant capacity in the DAFs, sand filter, and UV disinfection system is exceeded, the emergency bypass storage capacity of the AIWPS® Facility at full capacity is 14 days of bypass storage in the Maturation Ponds, 14 days in the recreational fields/emergency storage basins, and an additional 14 days if the internal freeboard of the ponds were also used. The sequence of bypass operation would be as follows. In the event of an emergency in which one or all of the tertiary elements were non operational, the Maturation Ponds which will contain treated final effluent will be isolated from the secondary effluent stream until they are drained by gravity to the recreation fields/emergency basins located at the northern end of the Resource Park site. The disinfected tertiary effluent in the smaller of the two Maturation Ponds whose volume is 1.5 MGD will continue to be pumped to the disposal field at an accelerated rate and emptied in approximately one day. The volume in the larger Maturation Pond will be emptied by transferring its disinfected tertiary volume to the emergency bypass basins by gravity. Then when the two Maturation Ponds are empty, the secondary effluent after undergoing disinfection by calcium hypochlorite will be discharged into the Maturation Pond and stored during the period of emergency bypass. Assuming that the tertiary facilities can be restored to operation within two to three weeks (one week of internal freeboard storage), the disinfected secondary effluent stored in the Maturation Ponds can be pumped back through the redundant tertiary process and discharged into the smaller of the two Maturation Ponds from whence it would be pumped to reuse or disposal at an accelerated rate in order to process the emergency bypass volume as well as the normal daily flow. In this way disinfected secondary effluent would be kept within the treatment plant until it could receive complete tertiary treatment and disinfection. The tertiary disinfected water that was advanced from the Maturation Ponds to the playing fields/emergency basins at the time of the emergency would irrigate the turf in the recreational fields and percolate at the lower end of the Resource Park site. Should the tertiary facilities be out of service for greater than three weeks, then the disinfected secondary effluent would be discharged by gravity into the recreational fields/storage basins that would be fenced and posted, but the likelihood of this ever happening is quite remote.

Given the low effluent turbidity, less than 2 NTU, that will be achieved by the AIWPS® Wastewater Treatment and Water Reclamation Facility in order for UV to be used as the preferred method of final disinfection, the effluent from the AIWPS® Facility (disinfected tertiary effluent) will be suitable for disposal into gravity wells. And given the tentative approval of this disposal method by the Regional Water Quality Control Board, for all water not reused this is the selected method of final effluent disposal under the current Wastewater Project.

A number of locations for final effluent disposal by gravity wells were investigated by the County (Metcalf & Eddy, 1996; 1997). These same locations, the 80-acre Broderson property, the 206-acre Morro Palisades property, and the public right-of-way of Highland Avenue, are being investigated further as part of the planning and preliminary design of the current Wastewater Project. Two of these three sites are large undeveloped upland parcels that have significant habitat values. In order to use a portion of either the Broderson or Morro Palisades properties, purchase of additional land would be required. To avoid additional land costs beyond what will be required for the treatment facilities and Resource

Park (70 acres) and the mitigation land that may be required for the current Wastewater Project, disposing the final effluent through a linear array of gravity wells located in the public right-a-way of Highland Avenue or perhaps some combination of parallel linear arrays located in Highland and in the northern edge of either the Broderson property and/or the Morro Palisades property. Another, but less likely option, might be to dispose of the final effluent in gravity wells in a linear array in the public right-of-way of Bayview Heights or in parallel linear arrays located in the public right-of-way of Bayview Heights and the northern and eastern edge of the Morro Palisades property. However, this option would require additional forced main pipeline and pumping capacity due to its higher elevation.

Two wastewater disposal field design options are being considered as shown in Figure 1-14. The final disposal system design recommendation will be determined following completion of the planned drilling program, dry well testing, and ground water mounding analysis. Sensitive habitat issues at the Broderson and Morro Palisades properties have temporarily delayed the drilling program and impacts analysis. Option 1, Option 2, or a combination of the two options will provide a feasible disposal system for Los Osos.

DISPOSAL OPTION 1: PARALLEL LINEAR ARRAYS AT THE BRODERSON SITE

The feasibility of wastewater disposal at the lower elevation, northern half (40-acres) of the Broderson property was investigated by Metcalf & Eddy between 1995 and 1997 under contract to the County of San Luis Obispo (Metcalf & Eddy, 1996, 1997). The M&E draft report on Evaluation of Effluent Disposal at the Proposed Broderson Recharge Site (November 21, 1997) was reviewed by Cleath & Associates, who have proposed additional investigation and impacts analysis prior to final disposal system design.

The main issue yet to be resolved is the lack of adequate subsurface data to support the extrapolation of dry well pilot tests over the entire wastewater application area and to support the basin geometry used in the ground water mounding analysis. A drilling program has been developed to provide the needed information. Additional dry well testing is planned to determine the extent of the moisture front at equilibrium and refine well spacing. A re-evaluation of the M&E mounding analysis, in light of any changes in subsurface assumptions following the drilling program, is also planned.

The Broderson site disposal option includes 50-foot deep, 5-foot diameter dry wells with 40 gallon per minute (gpm) maximum flow rates and 100 percent system redundancy. A total of 18 active dry wells and 18 standby wells would be needed to handle the anticipated 1.0 million gallons per day maximum wastewater flow rate under the current Wastewater Project. Active dry wells would be spaced on 200-foot centers, with the standby wells offset 100-feet from the active wells (maintaining the 200-foot spacing for the standby wells). The total well field would require about 9 acres of land, and the 36 dry wells would be constructed as three linear arrays of 12 wells each. Each linear array would be set back from the northern property boundary at a distance of 100, 200, and 300 feet respectively (see Figure 1-14).

DISPOSAL OPTION 2: SINGLE LINEAR ARRAY

A single linear array of dry wells is an option which can be used to mitigate several potential problems related to the above clustered well field layout with three parallel linear arrays. The single linear array would be oriented roughly from east to west, perpendicular to the ground water flow direction, minimizing dry well moisture plume interference while maximizing attenuation of the ground water mound. The location of the single array would be parallel to Highland Avenue along the northern edge of the Broderson and Morro Palisades properties as shown in Figure 1-14 or within the County-maintained Highland Avenue public right-of-way. The latter option again has the advantage of avoiding additional land acquisition costs.

Assuming the same well spacing for a clustered and single linear array (200-foot centers for the active wells with 100-foot separation from standby wells), the total length for a single linear array of 36 dry wells would be approximately 3,500 feet. The length of Highland Drive is approximately 5,100 feet, therefore, the array could be installed either in the county right-of-way along Highland Avenue or anywhere to the south between Sea Horse Lane and Bayview Heights Drive. Cleath & Associates' planned drilling program includes test hole locations to allow concurrent evaluations of three candidate sites and two well field arrays.

IMPACTS ANALYSIS

As previously mentioned, the final system design recommendation will be determined following completion of the planned drilling program, dry well testing, and ground water mounding analysis. A summary of the potential impacts and corresponding system design modifications are presented below.

Potential impact:	Drilling program reveals fine-grained beds in the vadose zone that would lead to excessive lateral movement of moisture plumes and potential daylighting of percolating water downslope.
Design modification:	Deepen dry well design to penetrate below the fine-grained layers.

Potential impact:	Drilling program reveals edge of basin rises faster than previously modeled and revised ground water mounding analysis shows ground

	water will rise up into base of dry wells and/or will rise to unacceptably shallow levels downslope.
Design modification:	Shift dry wells into a linear array (Option 2). There is also room for a 50 percent increase in well spacing on the linear array.
Potential impact:	Pilot testing shows the equilibrium moisture front extends much farther from individual dry wells than indicated in short-term tests, leading to an unacceptable lateral migration of saturated moisture plume beneath residences.
Design modification:	Deepen dry well design and/or increase setback from developed lots. There is room for considerable setback on the Broderson site.
Potential impact:	Sensitive habitat issues restrict activity at Broderson site and there is insufficient room for a clustered layout of the dry well field.
Design modification:	Shift wells into linear array extending off-site or, if possible, beneath Highland Avenue.

SUMMARY OF EFFLUENT DISPOSAL OPTIONS

There are two design options being technically evaluated by Cleath & Associates for wastewater disposal in Los Osos. Feasibility studies performed by prior investigators have concluded that wastewater disposal at the Broderson site using dry wells is feasible. Should significant impacts arise during the planned drilling program, dry well testing, and ground water mounding analysis, design modifications will be made. Either Option 1, Option 2, or some combination of the two options will provide a feasible disposal system for the District.

WASTEWATER SOLIDS DISPOSAL

Within each of the two primary, 15-foot deep, Advanced Facultative Ponds within the AIWPS® Facility, there are deeper, quiescent zones called Fermentation Cells that are protected from wind-induced vertical mixing and the intrusion of cold, oxygen-bearing water in order to optimize the sedimentation and methane fermentation of biodegradable settleable solids and the stability of the sludge blanket. All of the collected septic tank effluent and septage overflow is introduced into either of two primary Fermentation Cells.

Because of their unique, patented design, these Advanced Facultative Ponds with special Fermentation Cells retain almost all of the settleable solids in a completely anoxic environment. There the three stages of anaerobic digestion take place culminating with methane fermentation. One of the unique features of the Fermentation Cells is their low volumetric organic loading rates as compared with the loading rates used in conventional separate sludge digesters. In the case of separate sludge digesters, because of their expense typically about two cubic feet of digester capacity per person is provided; whereas, in the case of Fermentation Cells, since they are much less expensive to construct on a per volume basis, typically about 50 cubic feet are provided per person. The results are that sludge in separate sludge digesters is only partially stabilized when withdrawn and requires special handling and disposal methods; whereas, because of its long residence time, primary sludge in an Advanced Facultative Pond settles and is completely stabilized and reduced to a volume so minute that the residual can be retained indefinitely and disposal of these residuals is rarely, if ever, required. Because of these facts, an AIWPS® Facility, if designed to prevent the intrusion of grit, will rarely, if ever, require solids removal. Nevertheless, two primary Advanced Facultative Ponds are provided as a safeguard against unforeseen events such as clogging of inlet pipes or repair after an earthquake.

AIWPS® Facilities do produce biosolids in the form of settleable microalgae which grow in the High Rate Ponds and partially settle out in the Algae Settling Ponds that received the effluent from the High Rate Ponds. These Algae Settling Ponds are designed to be decanted periodically, and the 3%-solids (dry weight) algal slurry that has accumulated on the bottom of the Algae Settling Ponds is pumped to the Algae Drying Beds that are underdrained. This algae, which is basically odorless, dries quickly and these "green chips" can be raked up or mechanically removed from the Algae Drying Bed surface. Although this algae does have sewage bacteria associated with it, after it has been stockpiled for several months, the bacterial concentration measured in MPN/gram dry weight of algal solids declines to levels below those specified in the federal 503 biosolids regulations and is safe to use as a nitrogen-rich (5% to 10% N) fertilizer and soil amendment at farms, parks, plant nurseries, and the like. Because of its high nitrogen content, dried algae must be used sparingly on plants that are sensitive to over-fertilization. The stock piled dried algae in the case of Los Osos will be handled in accordance with regulations now being reviewed by the State Water Resources Control Board.

yes, would be safe but no place authorized to put it besides the landfill.

Microalgae that are removed from water by Dissolved Air Flotation (DAF) contain some polymer and aluminum phosphate which are segregated and also dried on another portion of the Algae Drying Beds. This material because it contains polyvalent cations that may inhibit plant growth will be stockpiled separately from the more pure algae removed from the Algae Settling Ponds. The algae harvested by DAF will be of smaller volume and will also be odorless. Alum containing algae has been used as poultry feed in experiments at the University of California, Davis. However, because of the small quantity that is expected to be harvested by DAF at the Los Osos AIWPS® Facility, this dried algae will simply be stockpiled and held at the plant until it can be used to fertilize trees that are not as sensitive to polyvalent cations as are annual plants.

Concerning sludge disposal landfills or composting facilities, it is not likely that any such facilities will be needed to deal with any of Los Osos' wastewater biosolids. Other than algae, these solids will be mainly septage. Residuals from the septage receiving station described in Section 1 and Section 8 will be primarily grit which will require periodic removal to a legal landfill. There are two underground septage receiving vaults located at the southwest corner of the Resource Park site each with a capacity of retaining 18,000 gallons of septage for up to three days during which all of the grit should settle out of the septage. We estimate that removal of grit from the septage receiving station will be required at least every year or possibly three times every two years. This type of work will be carefully planned to avoid odor as described below.

During the cleaning procedure, the tank contents will be decanted into the Fermentation Cells of the two Advanced Facultative Ponds. Decanting the septage vaults will bring the septage liquid level down to the surface of the settled grit and other solid residues. These solids when of sufficient volume to require removal will be removed by a diaphragm pump into a closed tanker truck for transport to the landfill. The vaults once empty will be rinsed into the headworks with fresh water and returned to service as septage receiving stations. The vaults will normally be sealed and under negative pressure with off gases vented through a soil odor absorption filter to minimize objectionable odors.

INTRODUCTION

Section 4 presents an evaluation of the non-existence or possible existence of excessive infiltration and inflow (I&I) in the existing wastewater septic systems and as estimated for the proposed septic tank effluent gravity and septic tank effluent pumped (STEG/STEP) Wastewater Collection Facilities.

Because the Los Osos STEG/STEP Wastewater Collection System will be new, there are no data regarding the volume of local I&I although there are typical I&I data in septic tank manuals (U.S. EPA, 1991; WPCF, 1986). It is, however, unlikely that the pressurized STEP portion of the proposed collection system will have a significant amount of I&I. The STEG portion, approximately 70% of the total number of existing septic tanks that will be collected by gravity, could experience some I&I, but the potential is significantly lower than with conventional large diameter gravity sewers because of the smaller diameter STEG piping, the solvent welded joints used with plastic pipes, and the shallow depths at which STEG/STEP sewers are laid. The most likely sources of groundwater inflow are at the building sewers that run from the house or building to the septic tank and at the septic tank connections. Each of the initial 3,040 septic tanks and STEG/STEP connections will be inspected by Los Osos Community Services District Septic System Maintenance and Management Program (SSMMP) personnel prior and/or during the installation of the STEG/STEP Collection System and by the Design Engineer during installation to assure quality control and to minimize any potential leakage. This effort will minimize the potential for future I&I in the STEG/STEP Collection System.

Despite the relatively low probability of I&I in the Los Osos STEG/STEP Collection System due to the highly permeable local sandy soils, the relatively low average rainfall (15.8 inches per year based on rainfall recorded from 1961-1990 at the Morro Bay Fire Station), and the new small diameter, shallow plastic pipes and solvent welded connections, we have provided for potential I&I 16 gallons per capita per day or 33% additional flow above the national average for septic tank effluent (U.S. Department of Commerce, 1990; Water Pollution Control Federation, 1986). Rainfall data are shown in Figure 4-1, Figure 4-2, and Figure 4-3.

The usual duration of rain events in California rarely exceeds a few hours, but in rare instances may extend for one day. Such storms recur once or twice in 10 years and may deposit up to 6 inches of rain in 24 hours. Rare "cloud bursts" are experienced in California, although these may be so torrential that they overflow all rheological structures. Such cloud bursts rarely persist for more than ½ hour and rarely precipitate more than one or two inches. The Resource Park site where the wastewater treatment facilities are located has been preliminarily designed with a surface drainage channel sized to accommodate a 100-year that may last two days and deposit approximately ten inches of precipitation (the 100-year, 48-hour storm is 7.15 inches for Los Osos).Rainfall intensity duration frequency data indicate only very short periods of intense rainfall of greater than two inches.

In the case of the STEG/STEP Collection System design, provision has been made for a peak flow that is four times the mean design flow at full buildout capacity. Under the estimated peak flow conditions, the STEG pipes will run half full. We do not expect average flow to exceed 65 gallons per capita per day.

Regarding the impact of potential I&I on the wastewater treatment facilities, it should be noted that the long hydraulic residence time (28 days at full capacity of 1.0 MGD) in addition to the freeboard and oversized hydraulic transfer structures provided within each pond of the AIWPS® Wastewater Treatment and Water Purification Facility will attenuate and buffer any peak flows that might result from I&I during periods of intense rainfall. The 100-year, 24

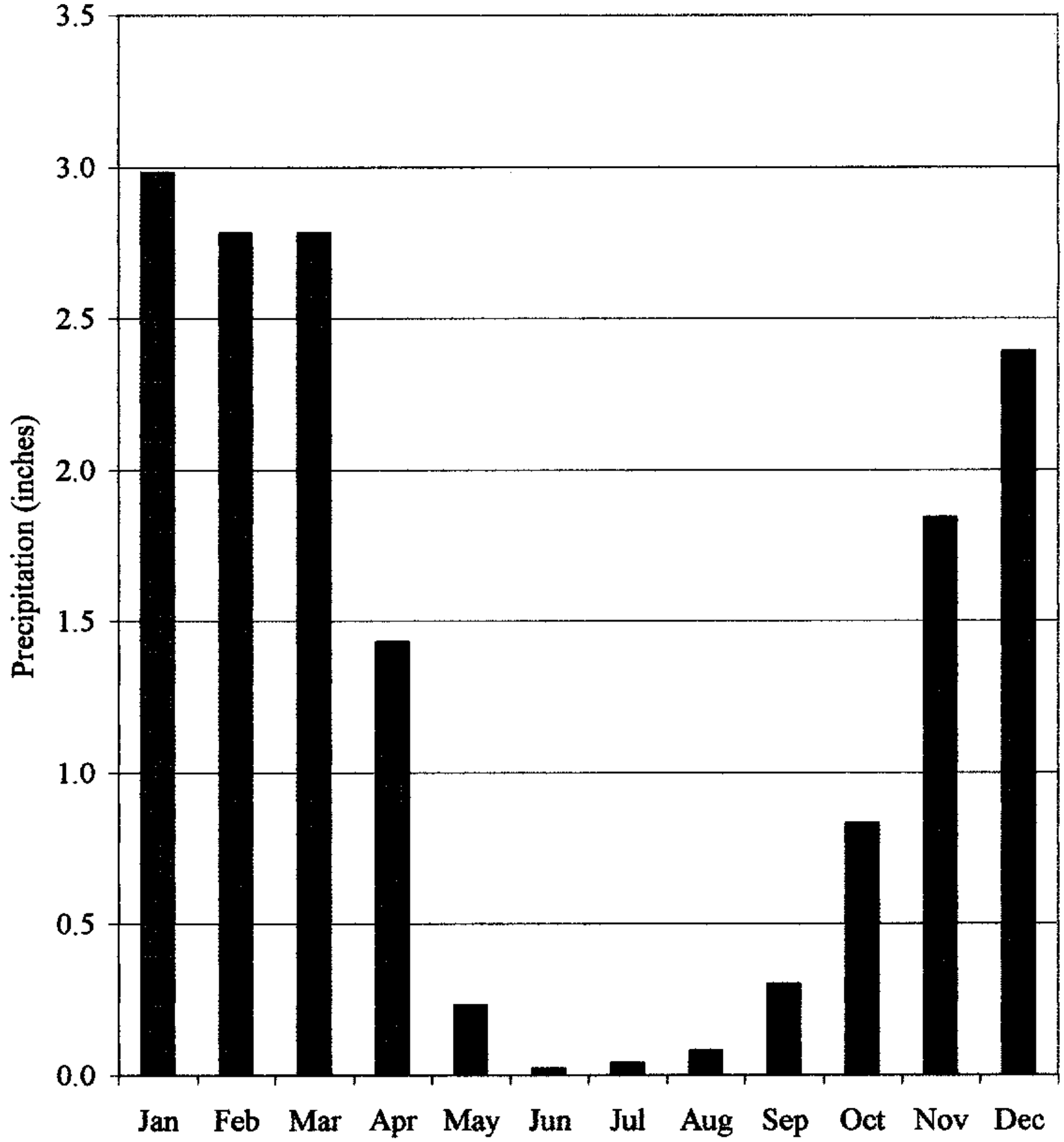


Figure 4-1. Average monthly rainfall derived from average daily data for the period 1961-1990 collected at the Morro Bay Fire Station (Latitude: 35°22'N, Longitude: 120°51'W, elevation 115 ft). Data were archived by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center.

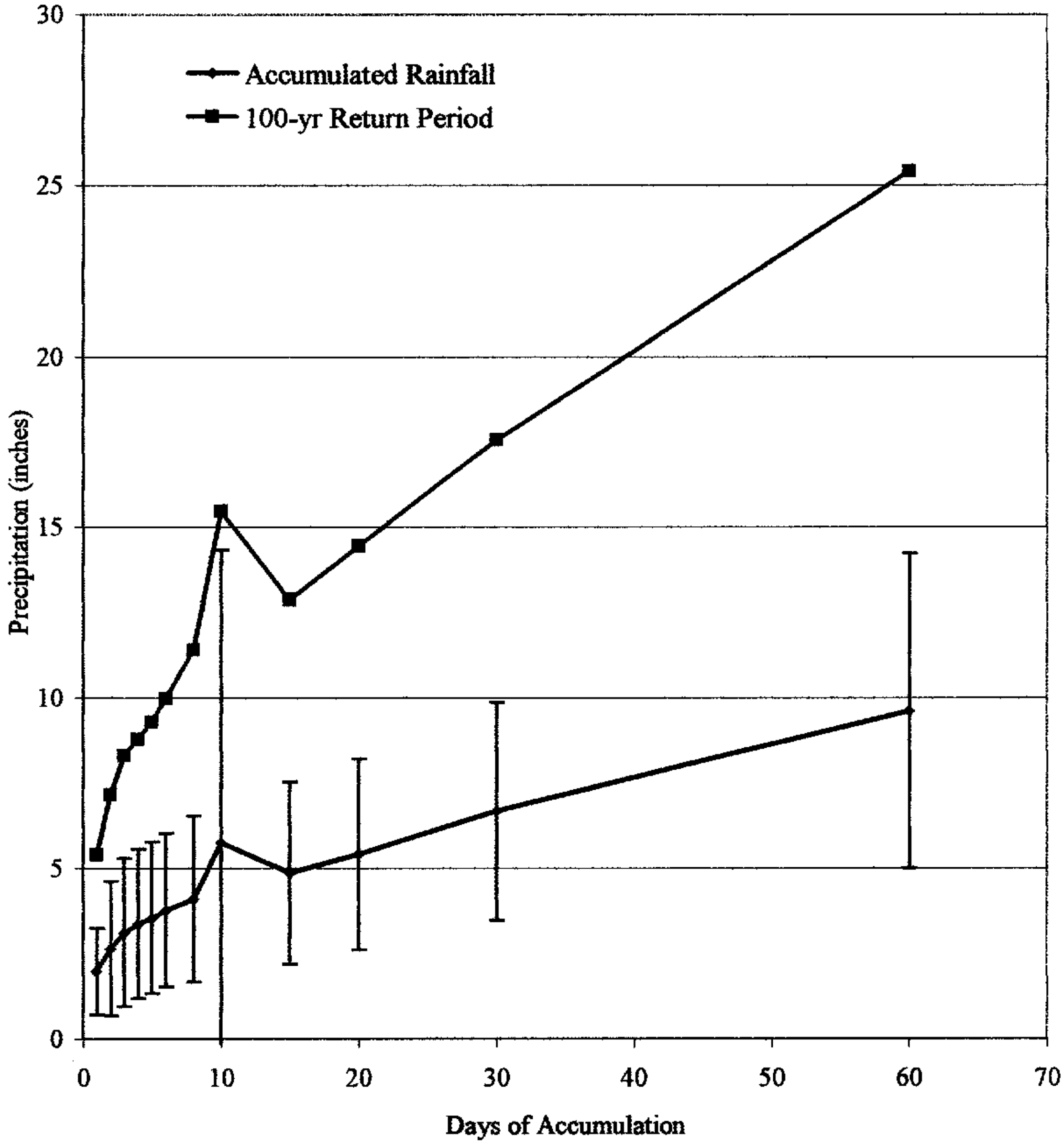


Figure 4-2. Average rainfall accumulated and the 100-year return period over the given number of days for the period 1960-1997 at the Morro Bay Fire Station (Latitude: 35°22'N, Longitude: 120°51'W, elevation 115 ft). Data analysis: California Department of Water Resources. Bars indicate ± one standard deviation.

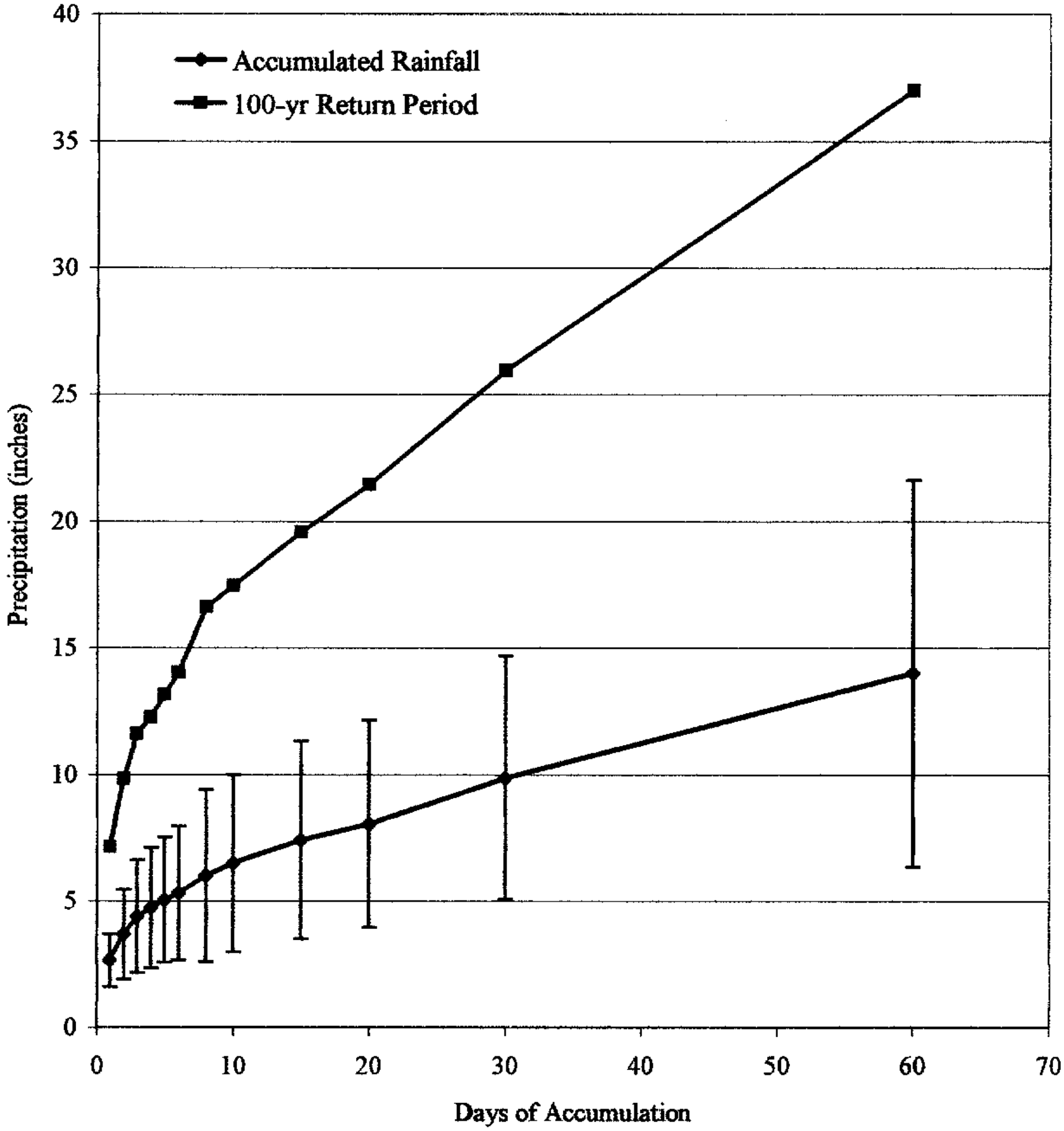


Figure 4-3. Average rainfall accumulated and the 100-year return period over the given number of days for the period 1949-1997 at the California State Polytechnic Institute (Latitude: 35°31'N, Longitude: 121°66'W, elevation 300 ft). Data analysis: California Department of Water Resources. Bars indicate ± one standard deviation.

hour rainfall for Los Osos is 5.4 inches (California Department of Water Resources, 1997). Even twice this amount of rainfall would occupy less than half of the available freeboard in each pond of the AIWPS® Wastewater Treatment and Water Purification Facility leaving additional capacity for peak flows. Also the tertiary elements of the AIWPS® Facility, the Dissolved Air Flotation clarifiers, the sand filter, and the disinfection facilities each have excess capacity of between 50% and 150% that could be used to handle excess peak flows resulting from a 100-year storm and the associated potential I&I.

Again it is noted that pond systems are mainly designed on the basis of organic loading and are capable of accepting much higher than design flows over short periods of time. Thus even if I&I exceeds 65 gallons per capita per day or if flows are temporarily higher than otherwise expected, it would have little effect on the overall treatment.

SUMMARY

Excessive inflow and infiltration (I&I) are more associated with conventional, large diameter, gravity sewers than with STEG/STEP collection systems. The majority of the STEG/STEP collection system at Los Osos will be gravity, but approximately 25% to 30% of the collection system will be STEP pressure sewers. Being new and smaller diameters piping, the STEG/STEP collection system will be much less susceptible to I&I than are conventional gravity sewers as proposed in the three previous wastewater projects for Los Osos.

INTRODUCTION

In order to make a preliminary estimate of the proposed wastewater facilities, we have prepared tables which list the materials and quantities for each component of the Wastewater Project: the STEP/STEP Collection System; the AIWPS® Facility; the Broderson, Morro Palisades, and/or Highland Avenue gravity well disposal system; the extension of Skyline and Palisades; and, the storm water retention basin and creek corridor. All of the estimated costs associated with these components are summarized in Table 5-1.

Table 5-2 is a list of materials, quantities, and installed costs for the STEG/STEP Collection System including pumps, wet wells, septic tank retrofits, septic tank replacements (non-project costs), collection pipe, mountings, valves, and standby power supply.

Table 5-3 is a lists materials, quantites, and installed costs for the AIWPS® Facility including headworks and flow metering designed to avoid any contact of septic tank effluent with the atmosphere to avoid odor. Also required are two Advanced Facultative Ponds, four High Rate Ponds, pumps for recirculation of High Rate Pond effluent, two Algae Settling Ponds, two Dissolved Air Flotation units, one intermittently-backwashed sand filter, one UV disinfection unit, and one standby chlorination station, two buildings, piping, transfer structures, controls, and appertenances.

Table 5-4 is a list of the materials, quantities, and cost for the disposal facilities including effluent storage in two contiguous Maturation Ponds, an effluent pumping station, a forced main from the pumping station to the disposal area, and the network of gravity wells, values and controls.

Table 5-5 lists materials, quantities, and installed costs for two new roadways in the Resource

Park (the extension of Skyline and Palisades) and road improvements along Los Osos Valley Road.

Table 5-6 lists materials, quantites, and installed costs for the stormwater drainage management system including improvements on Los Osos Valley Road, a retention basin; and, lighting and landscaping of each of the above elements.

Table 5-7 summarizes the materials, quantities, and costs associated with the 10.8 acres of Community Park and trails. There may be special funding opportunities for the Community Park, so we have separated its costs from those of the wastewater facilities.

It should be noted that in all preliminary cost estimations, contingencies, in this case 30% of the estimated construction, are used in proportion to the level of design detail in an effort to avoid underestimation. However, every effort will be made in the design-build phase to minimize cost and to avoid using the contingencies whenever possible.

Table 5-1. Summary of Wastewater Project Capital Costs.

Description	Cost (millions)
Planning and Predesign[1]	$1.5
Two new roads, road improvements along Los Osos Valley Road, drainage retention and conveyance, and landscaping	$0.6
Drainage Corridor	$1.8
STEG/STEP Collection	$11.4
AIWPS® Treatment	$6.8
Disposal System	$3.0
Total Construction[2]	$23.6
Contingency (30% of Construction)	$7.1
Subtotal	$30.7
Engineering and Administration (20%)	$6.1
Subtotal	$36.8
Land Purchase-Resource Park	$7.5
Land Purchase-Mitigation	$5.0
Land Purchase-Disposal	$0.5
Total Planning, Design, Construction, and Land (Sum of shaded cells)	$51.3

[1] Planning, preliminary design, financial planning, environmental, geotechnical, hydrogeological, assessment engineering, project management, and legal environmental

[2] Includes contractor overhead & profit but excludes planning and preliminary design

Table 5-2. Preliminary materials, quantities, and costs for the Los Osos Community Services District STEP/STEP collection system.

Item #	Description	Quantity		Unit Cost Installed	Project Cost	Non-Project Cost[1]
1	**Pump Stations**					
2	3-HP pump (P1, 90 gpm, 60' lift)	2	each	$1,585	$3,170	
3	85-HP pump (P2, 1,400 gpm, 120')	2	each	$10,843	$21,686	
4	3-HP pump (P3, 250 gpm, 25')	2	each	$1,640	$3,280	
5	35-HP pump (P4, 550 gpm, 130')	2	each	$9,133	$18,266	
6	10-HP pump (P5, 150 gpm, 115')	2	each	$3,321	$6,642	
7	25-HP pump (P6, 465 gpm, 110')	2	each	$10,843	$21,686	
8	1-HP pump (P7, 70 gpm, 30')	2	each	$1,385	$2,770	
9	10-HP pump replacement (P8, 150 gpm, 120')	2	each	$7,451	$14,902	
10	10-HP pump (P9, 570 gpm, 35')	2	each	$3,226	$6,452	
11	10-HP pump (P10, 300 gpm, 70')	2	each	$3,321	$6,642	
12	2-HP pump replacement (P11, 90 gpm, 30')	2	each	$1,635	$3,270	
13	2-HP pump replacement (P12, 80 gpm, 20')	2	each	$725	$1,450	
14	2-HP pump replacement (P13, 70 gpm, 20')	2	each	$820	$1,640	
15	10,000-gal wet well	1	each	$30,000	$30,000	
16	5,000-gal wet well	2	each	$15,000	$30,000	
17	2,000-gal wet well	3	each	$6,000	$18,000	

Item #	Description	Quantity		Unit Cost Installed	Project Cost	Non-Project Cost[1]
18	500-gal wet well	3	each	$1,500	$4,500	
19	Contol box	13	each	$5,000	$65,000	
20	MCC and switch gear	13	each	$8,000	$104,000	
21	Remote telemetry and level control	13	each	$7,800	$101,400	
22	**Septic Tank Improvements**					
23	STEG replacement septic tanks ($2,000 non-project for tank)	420	each	$1,500	$630,000	$840,000
24	STEG retrofitted septic tanks	1,230	each	$1,500	$1,845,000	
25	STEP replacement septic tanks ($2,000 non-project for tank)	230	each	$3,500	$805,000	$460,000
26	STEP retrofitted septic tanks	670	each	$3,500	$2,345,000	
27	STEG retrofitted septic tanks, multi-family	220	each	$2,500	$550,000	
28	STEG retrofitted septic tanks, commercial	250	each	$3,000	$750,000	
29	STEG retrofitted septic tanks, mobile homes	5	each	$3,000	$15,000	
30	STEG retrofitted septic tanks, motels	5	each	$3,000	$15,000	
31	STEG retrofitted septic tanks, restaurants	7	each	$3,000	$21,000	
32	STEG retrofitted septic tanks, schools	3	each	$3,000	$9,000	
33	**Pipes and Fittings**					
34	3"ϕ PVC in pavement	92,500	ft	$17	$1,572,500	
35	3"ϕ PVC not in pavement	1,500	ft	$10	$15,000	
36	3"ϕ PVC common trench	1,000	ft	$6	$6,000	
37	4"ϕ PVC in pavement	11,900	ft	$20	$238,000	

Item #	Description	Quantity		Unit Cost Installed	Project Cost	Non-Project Cost[1]
38	4"ϕ PVC common trench	2,500	ft	$10	$25,000	
39	6"ϕ PVC common trench	3,700	ft	$18	$66,600	
40	6"ϕ PVC in pavement	9,200	ft	$30	$276,000	
41	6"ϕ PVC not in pavement	1,100	ft	$15	$16,500	
42	8"ϕ PVC common trench	5,500	ft	$25	$137,500	
43	8"ϕ PVC in pavement	14,800	ft	$40	$592,000	
44	8"ϕ PVC not in pavement	500	ft	$25	$12,500	
45	10"ϕ PVC in pavement	3,500	ft	$50	$175,000	
46	12"ϕ PVC in pavement	2,500	ft	$60	$150,000	
47	12"ϕ PVC not in pavement	1,700	ft	$30	$51,000	
48	12"ϕ PVC common trench	1,900	ft	$30	$57,000	
49	4" x 300' directional boring	4	each	$30,000	$120,000	
50	6" x 300' directional boring	3	each	$30,000	$90,000	
51	8" x 300' directional boring	2	each	$30,000	$60,000	
52	10" x 300' directional boring	2	each	$30,000	$60,000	
53	3" isolation valve	80	each	$400	$32,000	
54	4" isolation valve	15	each	$500	$7,500	
55	6" isolation valve	10	each	$600	$6,000	
56	8" isolation valve	15	each	$900	$13,500	
57	10" isolation valve	3	each	$1,200	$3,600	
58	12" isolation valve	5	each	$1,600	$8,000	
59	Automatic 316 SS air release valves with soil bed filter	40	each	$2,500	$100,000	
60	**Back-up Power**					
61	150 kW trailer-mounted generator	1	each	$40,000	$40,000	

Item #	Description	Quantity		Unit Cost Installed	Project Cost	Non-Project Cost[1]
62	Pumping station land acquisition	13	each	$5,000	$65,000	
63	Subtotal				$11,445,956	$1,300,000
64	Contingency (30%)				$3,433,787	$390,000
65	Subtotal				$14,879,743	$1,690,000
66	Engineering and administration (20%)				$2,975,949	$338,000
67	Total STEG/STEP collection system				$17,855,691	$2,028,000

[1] Non-Project Costs are those costs that are bourne by home owners and not by the Los Osos CSD.

Table 5-3. Preliminary materials, quantities, and costs for the Los Osos Community Services District AIWPS® Wastewater Treatment and Water Purification Facility.

Item #	Description	Quantity		Unit Cost Installed	Cost
1	**General**				
2	Mobilization, erosion control, bonds, etc.	1	LS	$250,000	$250,000
3	Clearing and grubbing	70	ac	$2,100	$147,000
4	Overall site earthwork (175,000 yd^3 cut and used for fill)	175,000	yd^3	$8.00	$1,400,000
5	14' x 3"-thick AC service roads	112,000	ft^2	$1.20	$134,400
6	Operations building	2,000	ft^2	$150	$300,000
7	Maintenance building	1,250	ft^2	$50	$62,500
8	Operations building site landscaping	21,450	ft^2	$5.00	$107,250
9	Bridge one lane over creek	1	ea	$75,000	$75,000
10	Lighting	8.8	ac	$10,000	$88,000
11	Planted berm slopes	170,000	ft^2	$2.00	$340,000
12	Fencing	6,400	ft	$10.00	$64,000
13	2"ϕ washdown water supply	4,000	ft	$6.00	$24,000
14	**Septage Receiving & Treatment Station**				
15	16' x 11' x 32' reinf. PCC underground reservoir with a 32'-long central dividing wall and 4 manholes	1	ea	$70,000	$70,000
16	Hose couplers & rock screen	1	ea	$3,000	$3,000
17	Excavation for Septage Station	300	yd^3	$10	$3,000
18	Paving for Septage Station	1,400	ft^2	$2.00	$2,800
19	12"ϕ DIP spool (MJ x PE) w/ weep ring connectors	2	ea	$650	$1,300
20	6"ϕ DIP spool (MJ x PE) w/ weep ring connectors	2	ea	$450	$900

Item #	Description	Quantity		Unit Cost Installed	Cost
21	6"ϕ PVC septage influent pipe	20	ft	$15	$300
22	**Influent Meter, Splitter & Piping**				
23	18"ϕ DI tees and reducers	2	ea	$900	$1,800
24	18"ϕ DI pipe straight way to mag. meter	40	ft	$110	$4,400
25	18"-to-16" reducers	2	ea	$100	$200
26	16" ϕ magnetic flow meters	1	ea	$16,000	$16,000
27	6' x 6' x 3' reinf. PCC meter box	1	ea	$1,500	$1,500
28	6' x 10' x 5' reinf. PCC splitter box, underground w/ 2 manholes	1	ea	$6,000	$6,000
29	Excavation for meter & splitter boxes	15	yd^3	$10	$151
30	12"ϕ DIP spool (MJ x PE) w/ weep ring connectors	4	ea	$650	$2,600
31	18"ϕ DIP spool (MJ x PE) w/ weep ring connectors	2	ea	$900	$1,800
32	12"ϕ SS slide gate	4	ea	$2,400	$9,600
33	18"ϕ SS slide gate	1	ea	$2,800	$2,800
34	**Fermentation Cell influent piping & supports**				
35	12"ϕ PVC influent pipe splitters to Fermentation Cells	1,000	ft	$30	$30,000
36	14"ϕ x 8' PVC pipe support columns, tees, PCC fill	12	ea	$600	$7,200
37	18"ϕ PVC influent pipe	640	ft	$125	$80,000
38	4' x 9' x 6' reinf. PCC underground box w/ two 12"ϕ slide gate	1	ea	$5,000	$5,000
39	**Advanced Facultative Ponds** (combined quantities)				
40	4"-thick reinf. PCC water liner	34,800	ft^2	$3.00	$104,400

Item #	Description	Quantity		Unit Cost Installed	Cost
41	60-mil HDPE lower slope liner w/ attachment to PCC water liner w/ SS strips	101,500	ft²	$1.50	$152,250
42	HDPE liner base trench	2,500	ft	$0.50	$1,250
43	Geosynthetic clay lining for floors w/ 1' compacted backfill	142,000	ft²	$1.50	$213,000
44	12"ϕ effluent PVC pipe	230	ft	$30	$6,900
45	4' x 9' x 6' reinf. PCC underground effluent box w/ 12"ϕ slide gate	2	ea	$2,000	$4,000
46	12"ϕ DIP spool (MJ x PE) w/ weep ring connectors	2	ea	$650	$1,300
47	15-HP aspirating aerators w/ cables and shore anchorage	4	ea	$15,000	$60,000
48	5-HP aspirating aerators w/ cables and shore anchorage	2	ea	$8,000	$16,000
49	**Fermentation Cells**				
50	60-mil HDPE slope lining	13,440	ft²	$1.50	$20,160
51	60-mil HDPE flow deflection wall (height: 6' above ground + 2' buried) & 4" x 4" x 4' OC redwood support posts w/ PCC fill	320	ft	$10	$3,200
52	60-mil HDPE curtain wall	8,200	ft²	$3.00	$24,600
53	**High Rate Ponds** (combined quantities)				
54	Laser leveling of floor to ±½"	8.0	ac	$7,000	$56,000
55	2"-thick asphalt binder	7.5	ac	$18,500	$138,750
56	2"-thick asphalt concrete	7.5	ac	$20,000	$150,000
57	4"-thick reinf. PCC water liner	136,000	ft²	$3.00	$408,000
58	12-oz corrigated fiberglass divider wall (height: 4' above ground + 1' buried) & 4" x 4" x 4' OC redwood support posts	3,800	ft	$20	$76,000

Item #	Description	Quantity		Unit Cost Installed	Cost
59	4' x 9' x 6' reinf. PCC effluent box w/ 12"ϕ slide gate, rails, grates	2	ea	$3,500	$7,000
60	12"ϕ DIP spool (MJ x PE) w/ weep ring connectors	6	ea	$650	$3,900
61	12"ϕ effluent PVC pipe	845	ft	$25	$21,125
62	12"ϕ effluent DI pipe	80	ft	$50	$4,000
63	8'ϕ x 16' paddle wheel	8	ea	$12,000	$96,000
64	Motor, controller, pillow blocks, and couplers	8	sets	$1,500	$12,000
65	Reinf. cast-in-place PCC paddle wheel station	350	yd^3	$200	$70,000
66	**Recirculation Pumping**				
67	5-HP submersibile pump	2	ea	$3,000	$6,000
68	5'ϕ ID x 7' PCC sump	2	ea	$4,000	$8,000
69	4"ϕ sch. 40 PVC pipe	550	ft	$15	$8,250
70	4"ϕ DI pipe outlets	160	ft	$20	$3,200
71	**Algae Settling Ponds** (combined quantities)				
72	6"-thick compacted subgrade	5,600	ft^2	$1.00	$5,600
73	6"-thick reinf. PCC floor, ramps, and sump	5,600	ft^2	$6.00	$33,600
74	2-HP submersible diaphragm pump	2	ea	$3,000	$6,000
75	4"-thick reinf. PCC water liner	10,000	ft^2	$3.00	$30,000
76	60-mil HDPE lower slope liner	24,000	ft^2	$1.50	$36,000
77	18" x 24" x 20' aluminum crown-weir launders	4	ea	$6,000	$24,000
78	12"ϕ x 10' DI pipe columns w/ footings	12	ea	$1,500	$18,000
79	12"ϕ x 10' DI pipe effluent	40	ft	$50	$2,000

Item #	Description	Quantity		Unit Cost Installed	Cost
101	Earthwork cut	100	yd^3	$10	$1,000
102	3"ϕ PVC sch. 40 backwash piping to Broderson STEP pipeline	740	ft	$25	$18,500
103	Hydroclear® filter incl. ancillary pumps and equipment	1	ea	$250,000	$250,000
104	12"ϕ PVC sch. 40 effluent pipe	20	ft	$25	$500
105	**UV Disinfection**				
106	6"-thick reinf. PCC slab	480	ft^2	$6.00	$2,880
107	Earthwork cut	93	yd^3	$10	$933
108	IDI Aqua Ray 40 VLS low-pressure UV disinfection unit	1	ea	$175,000	$175,000
109	Crane for lamp banks	1	ea	$6,000	$6,000
110	Cleaning PCC tank corrosion resistant	1	ea	$6,000	$6,000
111	Cleaning tank blower & pumps	1	LS	$5,000	$5,000
112	Transmissivity analyzer	1	ea	$30,000	$30,000
113	18"ϕ PVC effluent pipe	150	ft	$35	$5,250
114	**Emergency Chlorination Station**				
115	Contact basin	1	LS	$20,000	$20,000
116	Flash mixer	1	ea	$10,000	$10,000
117	Calcium hypochlorite tablet dosing equipment & controls	1	ea	$10,000	$10,000
118	**Underdrained Algae Drying Beds**				
119	30-mesh beach sand	3,600	yd^3	$23	$82,800
120	¾"ϕ drain rock	1,800	yd^3	$25	$45,000
121	Pea gravel	1,800	yd^3	$25	$45,000
122	3"ϕ perforated, PVC drain pipe	3,000	ft	$10	$30,000
123	2'ϕ x 6' reinf. PCC sump	1	ea	$1,000	$1,000

Item #	Description	Quantity		Unit Cost Installed	Cost
124	1-HP pump	1	ea	$200	$200
125	3"ϕ PVC pipe to STEP line	320	ft	$10	$3,200
126	**General Equipment**				
127	Drying Bed scraper vehicle	1	ea	$10,000	$10,000
128	Laboratory equipment	1	LS	$10,000	$10,000
129	**Electrical and Control**				
130	Plant electrical including MCC#1, service entrance, switch gear, breakers, motor controls, lighting transformer, and distribution panel	1	LS	$120,000	$120,000
131	MCC#2 for filters, UV, and effluent pump station	1	LS	$80,000	$80,000
132	Telemetry, wiring, panels, data collection points (approx. 20 points)	1	LS	$156,000	$156,000
133	Software, training, installation, start-up, and costs not covered above	1	LS	$25,000	$25,000
134	Effluent flow meter	1	ea	$6,000	$6,000
135	pH meters	2	ea	$3,000	$6,000
136	Dissolved oxygen meters	4	ea	$2,000	$8,000
137	Temperature probes	8	ea	$200	$1,600
138	Turbidimeter	2	ea	$1,500	$3,000
139	150-kVA backup generator	1	ea	$50,000	$50,000
140	250-gal fuel tank w/ berm	1	ea	$3,000	$3,000
141	Subtotal, AIWPS® Facility including contractor overhead & profit				$6,755,519
142	Contingency (30%)				$2,026,656
143	Subtotal, AIWPS® Facility				$8,782,175
144	Engineering and administration (20%)				$1,756,435
145	Total, AIWPS® Wastewater Treatment and Water Purification Facility				$10,538,610

Table 5-4. Preliminary materials and quantities list for the Los Osos Community Services District purified wastewater disposal system.

Item #	Description	Quantity		Unit Cost Installed	Cost
1	**Maturation Storage Ponds and Emergency Basin Structures**				
2	4"-thick reinf. PCC water liner, patterned and tinted or exposed aggregate	27,300	ft^2	$6.00	$163,800
3	60-mil HDPE lower slope liner	107,000	ft^2	$1.50	$160,500
4	HDPE liner trenches	2,300	ft	$0.50	$1,150
5	Geosynthetic clay liner	63,600	ft^2	$1.50	$95,400
6	18"ϕ PVC sch. 40 effluent pipe	80	ft	$125	$10,000
7	18"ϕ SS slide gate and structure	1	ea	$4,000	$4,000
8	12"ϕ PVC effluent pipe	330	ft	$75	$24,750
9	12"ϕ SS slide gate and structure	2	ea	$3,800	$7,600
10	Basin & pond earthwork (175,000 yd^3 cut and used for fill)	175,000	yd^3	$8.00	$1,400,000
11	Hydroseeding	638,700	ft^2	$0.10	$63,870
12	**Effluent Pump Station**				
13	70-HP centrifugal pump	2	ea	$17,000	$34,000
14	70-HP variable frequency drive	2	ea	$10,078	$20,156
15	4' x 6' x 20' reinf. PCC sump w/ 18"ϕ slide gate, grates, and railing	1	ea	$30,000	$30,000
16	8"ϕ PVC pipeline (Resource Park to Broderson Disposal Site)	2,650	ft	$65	$172,250
17	Gravity well field	1	LS	$752,000	$752,000
18	Street installation and manholes	1	LS	$90,000	$90,000
19	Subtotal				$3,029,476
20	Contingency (30%)				$908,843
21	Subtotal				$3,938,319
22	Engineering and administration (20%)				$787,664
23	Total disposal system				$4,725,983

Table 5-5. Preliminary materials, quantities, and costs for new roads and road improvements.

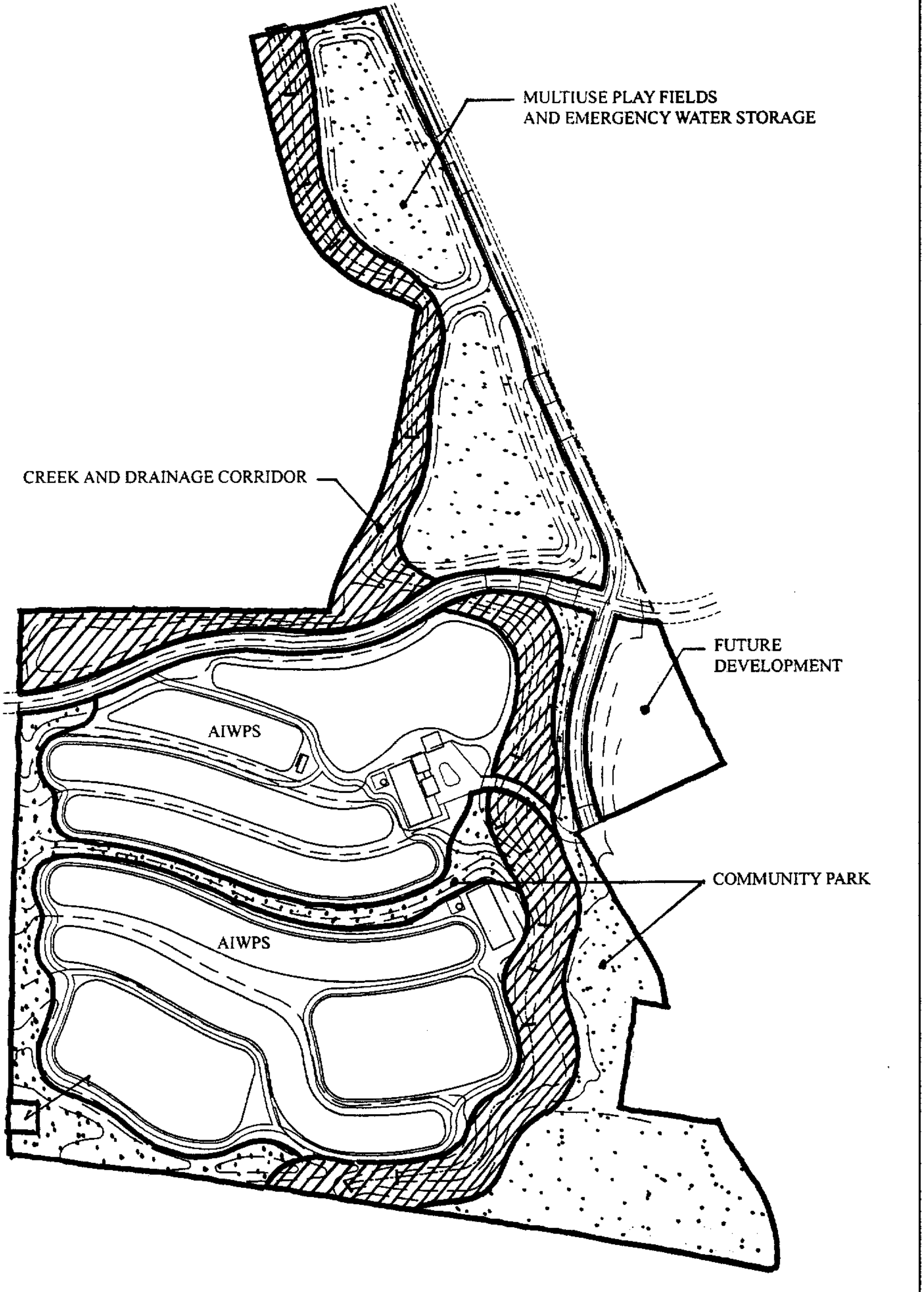
Item#	Description	Quantity		Unit Cost Installed	Cost
1	Skyline & Palisades extensions incl. curb and gutter	3765	ft	$85	$320,025
2	LO Valley Road widening incl. curb and gutter	1,910	ft	$45	$85,950
3	ROW landscaping	38,800	ft^2	$2.50	$97,000
4	Sidewalks	19,400	ft^2	$3.00	$58,200
5	Subtotal				$561,175
6	Contingency (30%)				$168,353
7	Subtotal				$729,528
8	Engineering and administration (20%)				$145,906
9	Total				$875,433

Table 5-6. Preliminary materials, quantities, and costs for the creek and drainage corridor (drainage management system).

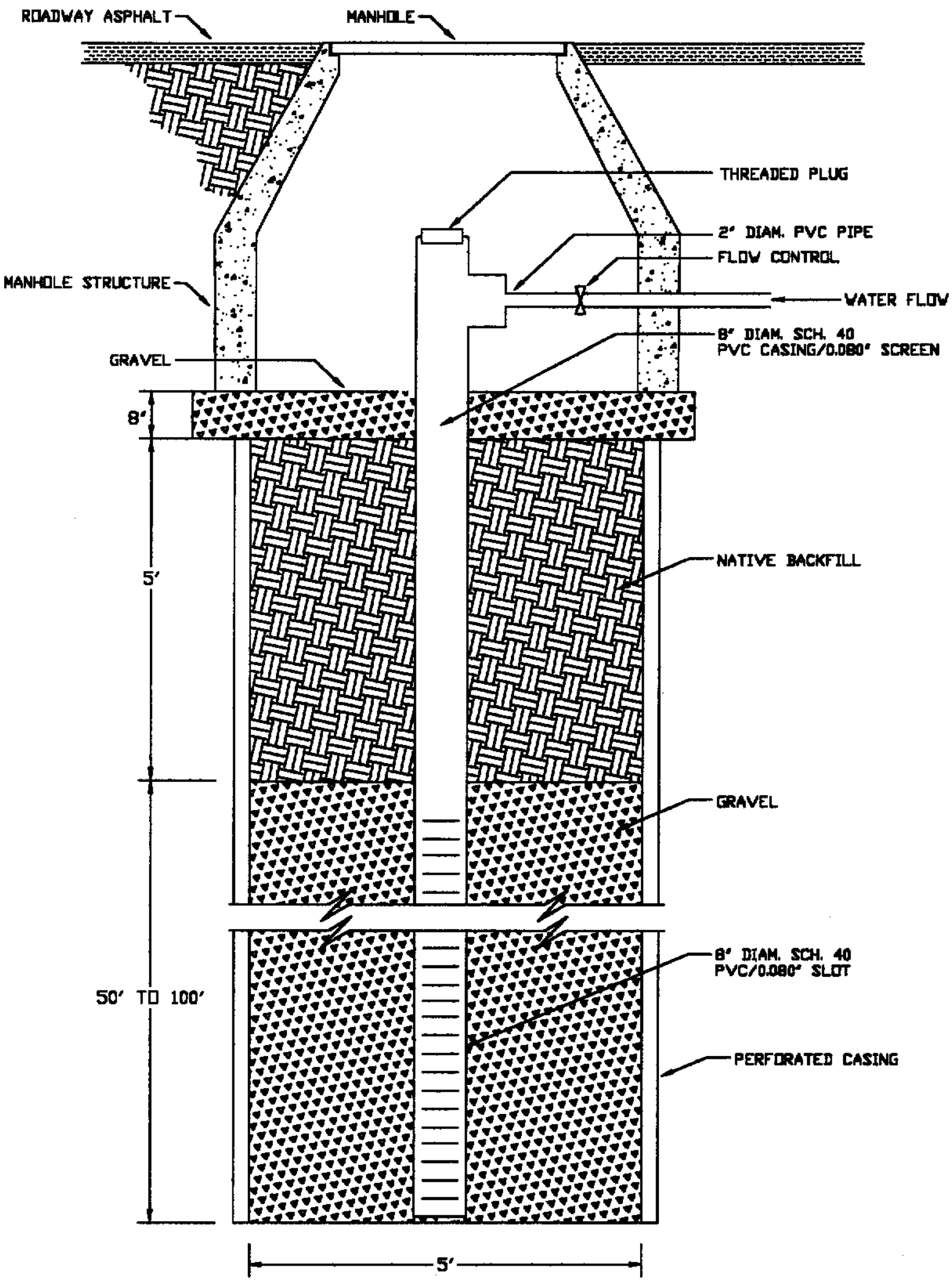
Item #	Description	Quantity		Unit Cost Installed	Cost
1	LOV Rd Improvements	1	LS	\$51,300	\$51,300
2	Basin inlet structure	1	LS	\$5,000	\$5,000
3	Basin outlet structure	1	LS	\$10,000	\$10,000
4	Catch basin	4	ea	\$4,600	\$18,400
5	Junction structure	4	ea	\$5,000	\$20,000
6	Fossil filter	4	ea	\$600	\$2,400
7	SD outlet structure	1	ea	\$10,000	\$10,000
8	Staged basin spillway	15	ea	\$20,000	\$300,000
9	Storm drain–48"	1,000	ft	\$60	\$60,000
10	Storm drain-84"	1,200	ft	\$110	\$132,000
11	Erosion control	1	LS	\$2,500	\$2,500
12	Hydroseed/stabilization	588,000	ft^2	\$0.10	\$58,800
13	Ground cover/planting/irrig.	294,000	ft^2	\$3.50	\$1,029,000
14	Temporary irrigation	294,000	ft^2	\$0.50	\$147,000
15	Subtotal				\$1,846,400
16	Contingency (30%)				\$553,920
17	Subtotal				\$2,400,320
18	Engineering and administration (20%)				\$480,064
19	Total				\$2,880,384

Table 5-7. Community Park Capital Costs (non-project costs).

Item #	Description	Quantity		Unit Cost Installed	Cost
1	Fine Grading	638,700	ft^2	$0.12	$76,644
2	Landscaping/Irrigation/Lighting	638,700	ft^2	$3.50	$2,235,450
3	Multi-use Paths	17,000	ft	$15	$255,000
4	Subtotal				$2,567,094
5	Contingency (30%)				$770,128
6	Subtotal				$3,337,222
7	Design and administration (20%)				$667,444
8	Total Community Park				$4,004,667



DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	COST ESTIMATE AREAS	SOURCE: SWA GROUP DATE: JAN. 31, 2000	FIGURE **5-2**



NOT TO SCALE

DRAFT PROJECT REPORT	**LOS OSOS COMMUNITY SERVICES DISTRICT** LOS OSOS, CALIFORNIA	***OSWALD ENGINEERING ASSOCIATES, INC.*** CONCORD, CALIFORNIA	GRAVITY WELL SECTION CONCEPTUAL SCHEMATIC	DESIGN: OEA, CLEATH DATE: JAN. 31, 2000	FIGURE **5-3**

FLOWS AND POPULATION

The population of Los Osos counted by the 1990 Census was 14,653 people. Since the building moratorium was in effect prior to the 1990 Census, this population number is assumed to be the current population of Los Osos. Considering both the maximum potential population at full build-out as currently estimated by the County using the zoned dwelling unit densities allowed under the existing General Plan and, considering the adjustment in the maximum potential population at full build-out that would occur in the proposed zoning as recommended in the draft General Plan update, entitled *Estero Area Plan*, recommended by both the Los Osos Community Advisory Council and the Cayucos Advisory Council, it is our professional engineering judgment that the best, most probable, initial estimate of the maximum potential population for Los Osos at full build-out is 19,000 people. It is also our prediction that this maximum potential population of 19,000 people, if it is reached at all, will be reached soon after the wastewater facilities are designed, constructed and operational and the building moratorium is over, and certainly during the next 20 years by year 2020.

A Los Osos population projection made in 1982 by staff at the State Water Resource Control Board predicted a population size of 15,200 for the year 2000 as shown in Figure 6-1 (SWRCB Memorandum, 1982). It is interesting to note the accuracy of the year 2000 population projection; if the linear growth projection were extended over the next twenty years, the population in Los Osos would be approximately 20,000 people, closer to our initial estimate of the maximum potential population at full build-out than to the current County estimate of the maximum potential population at full build-out.

In providing the preliminary design of the wastewater collection, treatment and disposal facilities, we have used slightly more conservative estimates of the maximum potential

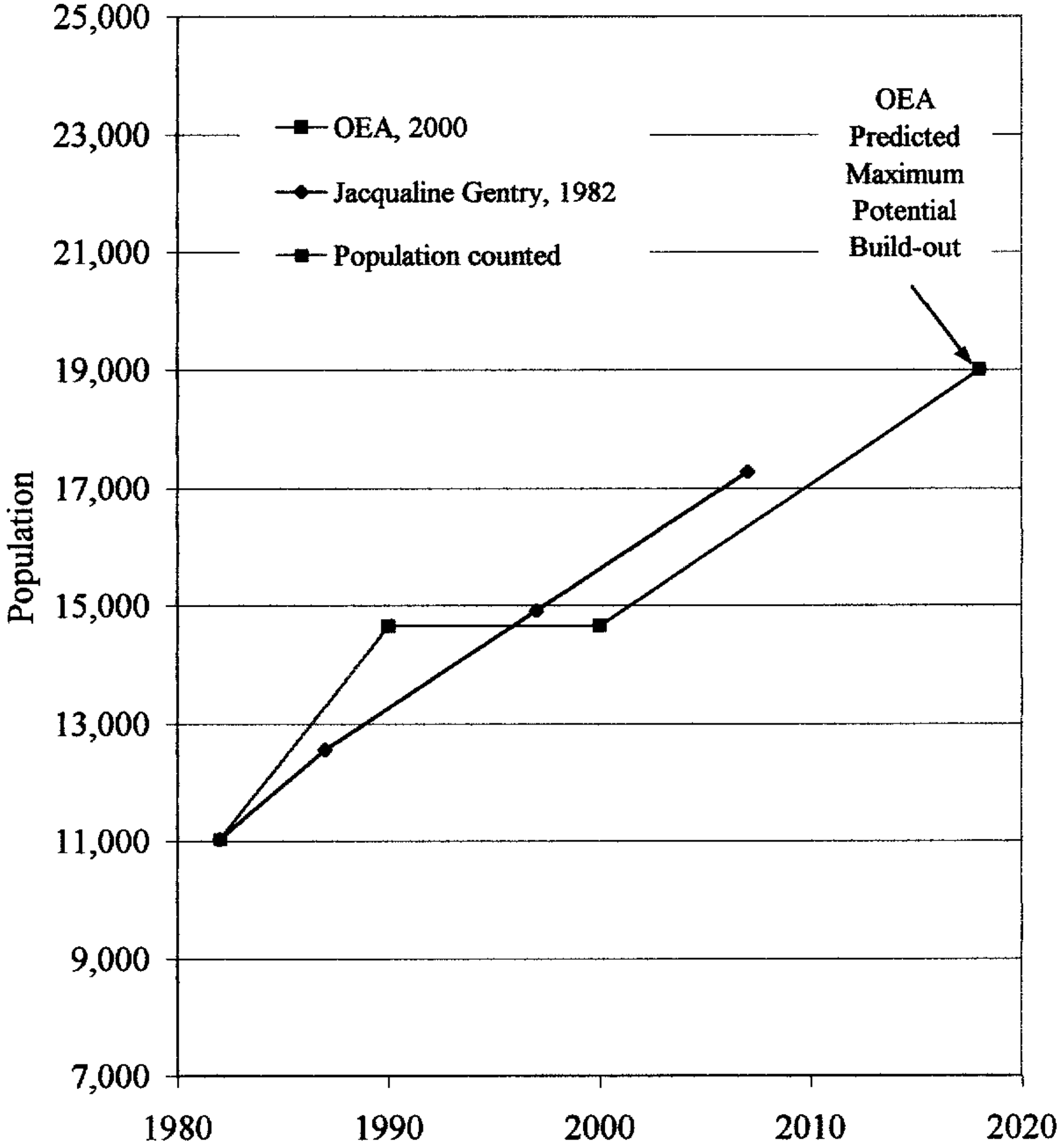


Figure 6-1. Los Osos Population Projections.
Source: 1982-2007: Jacqueline Gentry, SWRCB, 1982;
2000-2020: OEA

population at full build-out within the areas of septic tank effluent collection. The current septic tank collection area serves 3,951 existing dwelling unit equivalents (DUEs). With an assumed population equivalent (PE) per DUE of 2.5, the septic tank collection area will initially collect 9,878 PE. At 65 gallons per capita per day (gal/c/d) of septic tank effluent, the initial flow into the AIWPS® Wastewater Treatment and Water Purification Facility will be 609,000 gallons per day (gpd). Pressure sewers generally collect little I&I when properly designed and constructed. House sewers and septic tanks, however, may experience I&I.

The U.S. EPA *Manual on Alternative Wastewater Collection Systems* states that the per capita flows including I&I assumed traditionally by engineers are higher than those measured in recent decades.

> An allowance of 380 L/cap/day (100 gpcd) has been used as a general rule in the design of conventional sewer systems (Great Lakes-Upper Mississippi River Board of State Sanitary Engineers, 1978). However, that general rule may allow for more infiltration than may occur when pressure sewers are used, and it allows for some amount of commercial and industrial use that may not be present in pressure sewer design. Experience with pressure sewerage has shown a lower allowance to be more in order....At this time, thousands of flow measurements have been made on pressure sewer systems with wide demographic spread (Thrasher, 1988). The result of these measurements has corroborated findings of the earlier studies; that flows are typically 150-230 L/cap/day (40-60 gpcpd), with little weekly or seasonal variation.
>
> The availability and quality of water affects water use and consequently sewer flows, as does water pressure, community affluence, nature of occupancy, and attitudes of the users regarding water conservation. Because of these variables and to provide a safety factor, the flow rate normally assumed for design is 190-2645 L/cap/day (50-70 gpcd). system designed for 49 gpcd!

In the case of small gravity gravity sewers or STEG collecdtion systems, the U.S. EPA *Manual* notes the following:

> Conventional sewer design assumes 380 L/cap/day (100 gpcd) times a typical peaking factor of 4 for collector mains. This estimate includes allowances for commercial flows and infiltration. However, experience with SDGS (small diameter gravity sewers) has shown that these design flow estimates greatly exceed actual flows because most SDGS serve residential areas where daily per capita flows are far less than 380 L/cap/day (100 gpcd); the peak to average flow ratio is also less than 4 because the interceptor tanks attenuate peak flows markedly (Otis, 1986).
>
> Measured average daily wastewater flow per capita is approximately 170 L/d (45 gpd) (Anderson and Watson, 1975; Bennet and Linstedt, 1975; Otis 1978). However, in small communities and residential developments where little commercial or industrial activity exists, average per capita wastewater flows in sewers may be a much as 25 percent less (U.S. EPA. 1980). Household wastewater flow can vary considerable between homes but it is usually less than 227 L/d (60 gpd) and seldom exceeds 284 L/d (75 gpd) (Watson, 1967).

← 49 gpd used!

To mitigate against excess water use, we recommend that the Los Osos CSD water bills and sewer bills be submitted at the same time in order to indicate to the user that their sewer bills will be less if they use less water.

In deference to the information summarized by the U.S. EPA, we are using a conservative per capita septic tank wet weather effluent flow of 65 gallons per capita per day (gpcpd) and an average dry weather septic tank effluent flow of 49 gpcpd as derived in the following paragraphs and as measured at STEP/STEG collection systems in Oregon, northern California, and Wisconsin, all locations that have higher annual rainfall than Los Osos (WPCF, 1986).

Aside from the textbook estimates of septic tank effluent, usually in the range of 40 to 50 gallons per capita per day, actual water usage is the most accurate basis for estimating septic tank effluent flow unless, of course, infiltration and inflow (I&I) are severe. In other words, unless I&I are severe, mean septic tank output is determined by mean septic tank input. In the case of Los Osos, although wet periods are short in duration, I&I has been considered in designing the STEG/STEP Collection System. But I&I barely affects the AIWPS® Facility which is far more affected by organic loading than by short duration above average hydraulic loadings. Well production minus distribution losses equals water consumed at the meter or metered flow. Metered flow minus outside water use equals septic tank influent flow. Septic tank influent flow minus evaporation equals septic tank effluent flow.

In analyzing water usage, the quantity used in winter is obviously more representative of baseline household use than is summer usage. Because of the sandy soil in Los Osos, garden watering during dry periods in the winter is very common. According to Metcalf & Eddy water usage outside the house amounts to 22 gallons per capita per day in the winter (1995).

Los Osos CSD data for water production is still under study, but according to Cal Cities water production data for February 1997-1999 amounts to 80 gallons per capita per day. Their distribution line losses are said to be approximately 10% of production or 8 gallons per capita per day. Added to the 22 gallons per capita per day for winter outdoor water usage, the remainder is 50 gallons per capita per day; however, about 1 gallon per capita per day is lost through the septic tank ventilator. So the remainder is now 49 gallons per capita per day, our design value.

We have added 16 gallons per capita per day for infiltration. When septic tank effluent collection has drawn down the surface water levels such infiltration will only occur during heavy rains. Because of their inherent hydraulic buffering capacity, ponds are not usually adversely affected by hydraulic surges caused by the rates of I&I that are common in conventional gravity sewers, which would be greater than the rates of I&I experienced in the

STEG/STEP.

Table 6-1 shows the latest DUE counts for the STEG/STEP Collection System assuming the area of collection shown in Figure 1-3 which includes Redfield Woods, Los Osos Highlands, Morro Palisades, and Bayridge Estates. The issue of population-based flows and capacity of the Wastewater Facilities will be addressed again in Section 10.

Table 6-1. Existing and Build-out DUE counts for the STEG/STEP Collection System including Redfield Woods, Los Osos Highlands, Morro Palisades, and Bayridge Estates.

	Existing			Build-out		
Category	Unit	Conn.	DUE	Unit	Conn.	DUE
Single Family Residential 1 DUE/home	2,612	2,612	2,612	3,573	3,573	3,573
Multi-family Residential 0.75 DUE/home	923	215	692	1,843	400	1,382
Mobile Home 0.5 DUE/home	490	5	245	490	5	245
Motel DUE=80 x BR ÷ 375	2	2	10	2	2	10
Cafes DUE=40 x seats ÷ 375	20	20	63	20	20	63
Schools DUE=20 x no. students & faculty ÷ 375	3	3	65	3	3	65
Commercial DUE=1 DUE/10,000 sq. ft.	110	110	260	137	137	369
Total	4,160	2,967	3,947	6,068	4,140	5,707

Unit: number counted
Connection: number of service connections to main
DUE: Dwelling Unit Equivalents

Studies of maximum potential population at full buildout by Los Osos Community Services District personnel and engineers plus recent studies by our STEG/STEP expert all agree closely with the population projections made by the SWRCB (1982). The septic tank effluent collected area is approximately 64% of the total area of potential development within the Prohibition Zone. The area of the Prohibition Zone was reduced by the area of the Resource Park that would be developed under the Los Osos Wastewater Project as either wastewater treatment facilities (approximately 29.5 acres) or park (approximately 33 acres) or road right-of-way (4.5 acres), and thus would be unavailable for future development (37 total acres removed from potential development) and by the lower portion of the 206-acre Morro Palisades property (112 acres) that lies within the Prohibition Zone that might be acquired for habitat mitigation or partially developed as wastewater disposal facilities should the Broderson Site prove to be less desirable as a wastewater disposal site pending further hydrogeological investigations, and thus be unavailable for development. It is of interest to note the difference between the permitted development potential under the existing General Plan for the lower portion of the Morro Palisades Property and the recommended development density under the draft update to the General Plan (Estero Area Plan). Under the existing General Plan the County Planning Office is assuming a maximum potential development of 502 dwelling units in the lower 112-acre portion of the Morro Palisades Property; whereas, under the Estero Area Plan the County still estimates a range of between 452 and 501 dwelling units in the lower 112-acre portion. The reductions that would occur in these population growth estimates based on potential maximum development densities are reflected in our initial best estimate of the maximum potential population of Los Osos.

SECTION 7
SRF ELIGIBLE CAPACITY

Because of the unique character of the Los Osos CSD Wastewater Project, it is suggested that funding be provided to manage the wastewater of the current predicted buildout population of 19,000 as a minimum and preferable for a projected population of 20,000 in 2020. The AIWPS® Facility that is proposed, judging from experience with the AIWPS® Facility in St. Helena, California, will continue to function well at higher than design loads as it matures. In the Los Osos area, it is likely that population growth will occur on larger lots well beyond the prohibition zone. Within the prohibition zone, the AIWPS® Facility will provide sufficient nitrogen removal to mitigate the current concentrations of nitrogen in the groundwater. Because of the important impact of water supply on health, the projected population could increase to approximately 20,000, and because of its need for water conservation and wastewater reclamation, it appears reasonable that the Los Osos CSD should be provided the maximum loan available for a projected population of at least 18,745, and preferably for 20,000 PE.

As noted previously, to provide certainty in preventing odor, we have provided sufficient fermentation and aeration capacity for a collected population of 14,500 P.E. with a factor of safety of at least 1.5 which would therefore actually provide sufficient fermentation and aeration capacity for a population of 21,250 P.E. should that additional capacity ever be needed.

INTRODUCTION

Section 8 presents a detailed description of the best practicable wastewater collection, treatment, and disposal technologies and facilities that have been selected by the Los Osos Community Services District, pending environmental review, for its Wastewater Project. The proposed alternative selected by the community after examining many alternatives combines the STEG- and STEP-retrofitted existing septic tanks (those installed after 1978 that meet inspection standards) and replacement septic tanks for those that do not meet post-1978 standards; STEG/STEP Collection Facilities; an AIWPS® Wastewater Treatment and Water Purification Facility that includes septage treatment; and, a final effluent pumping station, forced main, and disposal facilities using gravity wells. In addition to the wastewater collection, treatment, and disposal facilities, the Wastewater Project also includes a comprehensive wastewater management, water conservation, and groundwater monitoring program as well as a Septic System Maintenance and Management Program (SSMMP) to provide periodic inspection and maintenance of septic tanks within the Urban Reserve Line. The septage pumped from septic tanks will be trucked to the Septage Receiving and Pretreatment Facility that will be located at the southwest corner of the Resource Park site. In order to avoid off site odor, the septage will be pumped from septage trucks through a closed line into a pair of underground tanks in which grit and sand will be removed from the septage before its overflow is conveyed by gravity with a portion of the STEG/STEP effluent into the primary Fermentation Cells of the two parallel Advanced Facultative Ponds (AFPs) that provide primary treatment in the AIWPS® Wastewater Treatment and Water Purification Facility. The interior of the septage tanks will be maintained under negative, that is, below atmospheric pressure, at all times, and the pressure reducing pump will be discharged into an underground soil odor absorbing filter.

An advantage of STEG/STEP over conventional sewers is the fact that they minimize inflow and infiltration (I&I) and hence do not require that treatment systems be enlarged to maintain minimum process residence time during peak flow periods. It has been known for at least 100 years that an ideal, virtually odor free, wastewater treatment technology consists of a septic tank (or Imhoff Tank) followed by an oxidation pond. The AIWPS® Technology simply locates a reactor equivalent to an anaerobic digester or septic tank within the primary pond which is designed in such a way that the important initial settling zone is sufficiently anoxic to support methane fermentation. The difference is that the fermentation cells are designed to have an extremely long sludge residence time permitting complete methane fermentation of the organic solids. As a result of this design more than half of the ultimate BOD and nearly all of the settleable solids of sewage origin are permanently removed and retained indefinitely with sludge residuals (primarily non-biodegradable inert solids and ash) requiring removal from the AFPs only after several decades. These primary units are designed taking climate and temperature into consideration.

The second pond in the AIWPS® Process sequence is the High Rate Pond (HRP) which is a major innovation in secondary aerobic wastewater treatment due to its photosynthetic oxygenation efficiency and its utilization of solar energy supplemented by mechanical aeration when needed. A HRP, due to photosynthetic oxygenation during daylight hours attains and retains much higher dissolved oxygen concentrations, as compared with those in a mechanically aerated aeration basin. O_2 is produced from water by algae rather than induced from an O_2 deficit as in a mechanically aerated aeration basin. In an HRP, there is always ample aerobic water to be recirculated to the surface of the primary Advanced Facultative Pond for odor control. In dark or cloudy periods, if the dissolved oxygen concentration falls below 3.0 mg/L supplementary aeration is provided to prevent any surface anoxia. Objectionable odor prevention is always a prime objective in the design of an AIWPS® Facility.

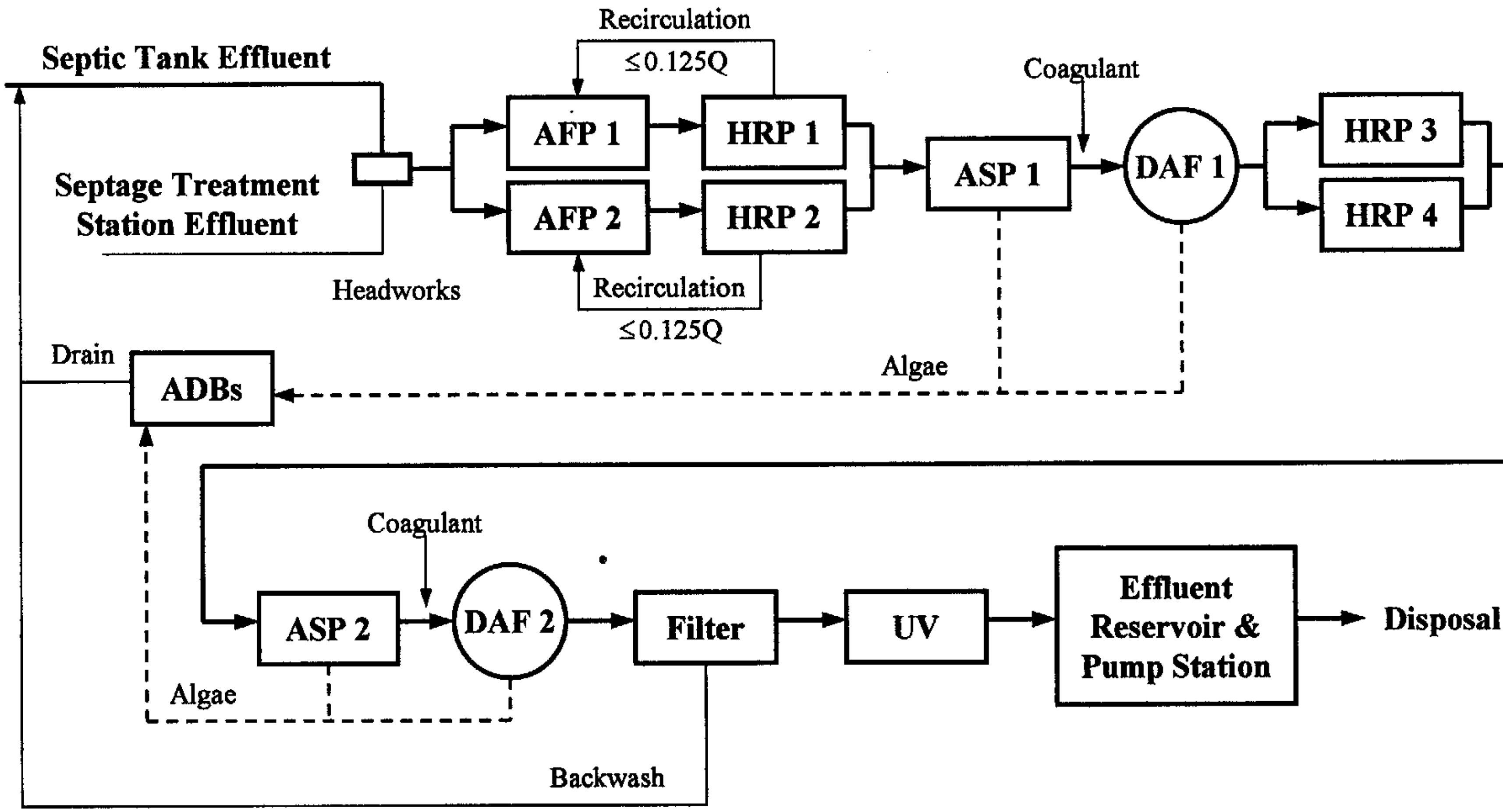


Figure 8-1A. AIWPS® Wastewater Treatment and Water Purification Facility Process Schematic.

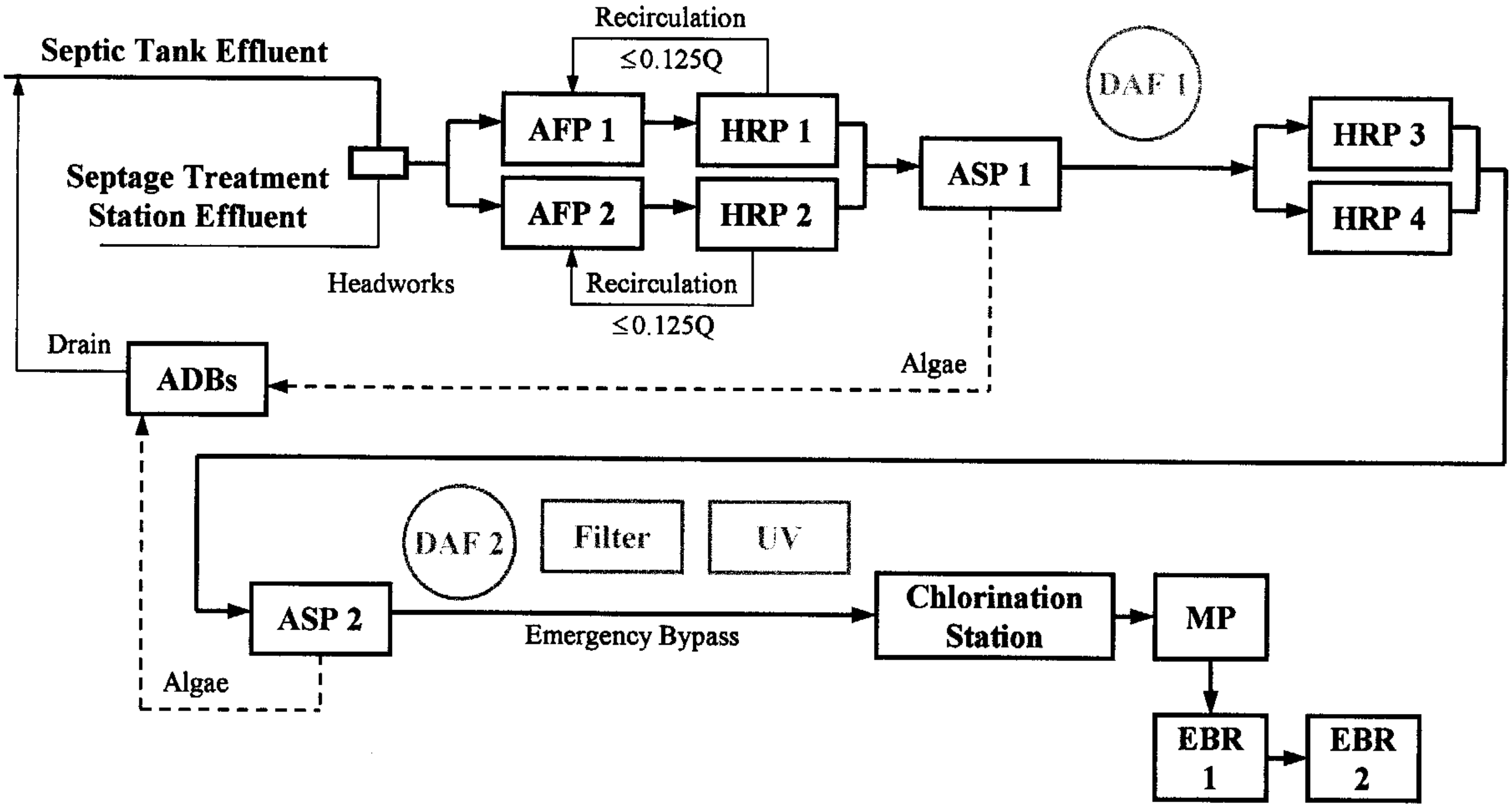


Figure 8-1B. AIWPS® Wastewater Treatment and Water Purification Facility Process Schematic in Emergency Tertiary Bypass Mode during which time the DAF, Final Filtration, and Final UV Disinfection units will be offline; the Maturation Pond (MP), chlorination station, and Emergency Bypass Reservoirs (EBRs) will be operated as needed.

THE AIWPS® TECHNOLOGY

The AIWPS® Wastewater Treatment and Water Purification Facility, shown in Figure 1-8, will consist of a series of fully lined ponds. The series will consist of two Advanced Facultative Ponds each with two sets of Fermentation Cells; four High Rate Ponds, two sets in parallel; two Algae Settling Ponds; two Dissolved Air Flotation (DAF) units; an intermittently backwashed sand filter; a UV disinfection unit. The final disinfected tertiary effluent is then stored in two contiguous Maturation Ponds prior to being pumped to the disposal site. Flow schematics under normal and emergency bypass conditions are shown in Figure 8-1A and Figure 8-1B.

To insure the protection of groundwater at the site of the AIWPS® Facility, all treatment ponds will be fully lined. Pond lining materials which will be selected during final design include geosynthetic clay liner (GCL) membranes overlain with compacted fill on the bottom and high density polyethylene (HDPE) plastic membranes on the side slopes of the Advanced Facultative Ponds and Maturation Ponds; asphalt over compacted road base for the bottom and shotcrete for the slopes of the High Rate Ponds; and, concrete for the bottom and HDPE for the slopes of the Algae Settling Ponds. Each pond of the series is designed to have an interior environment which, based on experimentally-derived information, fosters one or more appropriate natural physical, chemical and biological processes that will produce an effluent which consistently meets RWQCB requirements for a gravity well disposable effluent. A brief description of each element of the system and its function follows.

ADVANCED FACULTATIVE PONDS

The first pond of the series called the Advanced Facultative Pond (AFP) has three distinctly different zones and microbial populations: an aerobic surface, a facultative mid-depth, and an anaerobic bottom with isolated zones to optimize sedimentation, methane fermentation, and heterotrophic nitrification-denitrification. The purpose of the AFP is to provide for removal of BOD, suspended solids, and nitrogen. Two AFPs are provided so that one can be isolated from the other for maintenance, if needed. The AFPs will be 20 feet deep with 12-feet deep Fermentation Cells (FCs) at each end. To avoid odors from hydrogen sulfide that usually is present in septic tank effluent, the STEG/STEP effluent will be metered with closed, in-line magnetic meters and conveyed directly into the bottom of the FCs where residual settleable solids and BOD are removed.

The FCs are protected from the intrusion of overlying oxygenated water, and therefore, can undergo vigorous methane fermentation during the warmer periods of the year. On an annual basis, fermentation is so complete that only inert and refractory sludge remains and, based on AIWPS® Facilities in Richmond, St. Helena, Bolinas, and Delhi, California this sludge accumulates so slowly that it does not require removal from the FCs for decades, if at all. Also in the FCs, a significant fraction of the organic nitrogen and ammonium in the waste when the anaerobic consortium is mature will be converted to nitrogen gas via heterotrophic nitrification and denitrification (Oswald, et al., 1994). In addition to heterotrophic nitrification and denitrification and methane fermentation, the FCs provide for retention of parasitic helminth ova, heavy metals, and to some extent, chlorinated hydrocarbons. Most of the carbon dioxide produced during fermentation is absorbed by the overlying water and the carbon dioxide that is taken up by algae is sequestered rather than being released into the atmosphere as a greenhouse gas. BOD is further removed by aerobic bacteria growing near the AFP surface using oxygen introduced by aspirating aerators or, as the systems matures, through photosynthetic oxygenation both in the AFPs and in the secondary High Rate Ponds (HRPs). During start-up and subsequent cloudy periods, sufficient supplementary mechanical aeration will be used to control any odors in the AFPs. When start-up is complete, recirculation of oxygen-rich water from the HRPs usually will be sufficient for odor control, and to produce biosolids for denitrification of nitrate formed due to aeration. Aeration solids, produced through supplementary aeration will be used to denitrify any nitrate produced by the odor-control aerators. Reduction of any nitrate produced by aeration of ammonium will occur near the floor of the FCs at the effluent end of the AFPs. Since two AFPs will be used, they will have a combined residence time of 20 days at a depth of 5 m and a flow of 1 MGD. During the first few years of operation, the residence time will be well over 30 days. These primary units, as they mature, can accommodate flow and organic loadings much higher than design.

HIGH RATE PONDS

The purpose of the proposed AIWPS® Facility's High Rate Ponds (HRPs) is to remove nitrogen through incorporation into algal cells and to volatilize ammonium by increasing pH via carbon dioxide utilization. HRPs are endless, gently paddle wheel-mixed, raceways designed to grow a maximum crop of algae and to release a maximum amount of free molecular oxygen under controlled conditions. The oxygen released during photosynthesis by algae comes from water molecules (light + CO_2 + $2H_2O$ –> CH_2O + O_2 + H_2O) and is measured as dissolved oxygen (DO). The mechanism is described as follows: as algae grow they use light energy to extract hydrogen from water and use it to fix carbon dioxide and nitrogen as cell matter. Released oxygen ions normally combine to form DO, but they can also remain as short-lived free radicals with significant disinfecting properties. DO levels in the HRPs will frequently reach daytime supersaturation. This oxygen is immediately available in soluble form for commensal or symbiotic aerobic bacteria to oxidize any remaining soluble and colloidal biodegradable organic substances in the water. The gentle mixing applied with slowly rotating paddle wheels maintains algae suspended in the light, while most bacterial colonies, since they grow in clumps, tend to remain near the pond bottom where they receive sufficient oxygen for growth, but do not compete with the algae for light. The bacteria are also in a more favorable (neutral) pH zone at the pond bottom than they would be near the surface where the pH frequently is increased to 9.0 or higher as carbon dioxide is extracted from the water by growing algae. Nitrogen for growth of protein-rich algae is extracted from ammonium ions present in the wastewater or released by growing bacteria. By using HRPs in series, we make carbonate limiting which causes a rise in pH in the ponds. With this rise in pH, ammonium ions (NH_4^+) are converted to the gaseous ammonia (NH_3), which can be outgassed from warm water. Residual ammonia is released to the air as gas during intervals of elevated pH near the AFP surface. Finally we remove the algae by DAF. As a consequence almost all of the BOD and nitrogen is removed from the wastewater in the first three or four ponds while minimizing the expense of extended mechanical aeration. Grazing pressure by rotifers and other algal predators tends to maintain a population of microalgae which by natural selection are large enough to settle when they reach the Algal Settling Ponds.

ALGAL SETTLING PONDS

The purpose of the Algal Settling Ponds (ASPs) is to remove as much algae biomass as possible without chemical addition. ASPs follow HRP 2 and HRP 4. The ASPs are designed to be as quiescent as possible in order to permit sedimentation of the heavier algal species that have grown in the final gently mixed HRP. At least two ASPs in parallel are required so that the settled algae can be removed periodically. Removal of the settled algae is an important requirement for efficient nutrient removal because algae, although able to live for several months or more without light, eventually begin to deteriorate and release nutrients when they are allowed to remain for long periods at the dark, anoxic, floor of an ASP. The ASPs are accordingly designed to permit algal removal by pumping them to under-drained sand drying beds. After drying on the sand beds, concentrated algae can be used as a rich, slow release, fertilizer for above ground vegetables such as artichokes, tomatoes, and peppers, but since they have associated enteric bacteria, they should be tested to meet the requirements for biosolids reuse as promulgated by the State Water Resources Control Board in consultation with the State Department of Health Services.

DISSOLVED AIR FLOTATION, FILTRATION, DISINFECTION

Residual algae that do not settle naturally will be completely removed by using Dissolved Air Flotation (DAF) following the ASPs. A intermittently backwashed sand filter is used following the final DAF to assure the low turbidity (<2 NTU) required for UV disinfection. Standby chlorination will be provided should a long power failure occur.

MATURATION POND

The Maturation Pond (MP) allows additional natural disinfection and water purification. A second DAF followed by filtration to remove residual turbidity may be required for final disinfection and nitrogen removal. We recommend ultraviolet light (UV) disinfection to achieve an *E. coli* concentration of 2.2 most probably number (MPN) per 100 mL or less. Also disinfection by UV is known to kill indicator bacteria effectively and to minimize virus concentrations in the treated water. Although the added steps to completely remove algal turbidity increase the cost of the AIWPS® Facility, the total cost is still significantly less than the cost for more conventional tertiary treatment.

EMERGENCY BYPASS SYSTEM

If, for any reason, suspended solids removal fails and the MPN following disinfection exceeds 2.2 per 100 mL, an emergency storage area is provided. The volume of this storage will be 15 million gallons which together with the 2 ft of freeboard in the treatment ponds will provide sufficient holding time to permit any required repairs that will assure return to production of clear, low-nitrogen, disinfected water. All systems are designed to avoid short circuiting of the water in order to make full use of each unit's volume and corresponding residence time.

Another benefit of using the AIWPS® Technology is that during treatment in the HRPs, pH levels are sufficiently high to precipitate a large fraction of the calcium and magnesium (hardness) known to be in the water to be disposed. This is important because these ions seriously interfere with UV disinfection and consequently the UV lamps must be cleaned more frequently. Because calcium and magnesium form precipitates on UV tube protectors diminishing lamp intensity and, consequently, disinfecting efficiency, removal of calcium and magnesium hardness prior to UV disinfection is an ancillary benefit of the AIWPS® Technology. A disadvantage is that it will somewhat increase the sodium ratio and conductivity.

After many years of examining proposed methods of collecting and treating their wastewater, the community has proposed as the best wastewater management plan for Los Osos to collect and treat the septic tank effluent from approximately 75% of the septic tanks within the prohibition zone and all of the septage produced within the Urban Reserve Line using the STEG/STEP and AIWPS® Technologies. Experience indicates that the AIWPS® Technology will provide many economical, environmental, and hygienic benefits that would not be provided in more conventional wastewater technologies such as extended aeration (oxidation ditch) systems and sequencing batch reactors such as the Modified Lutzack Ettinger (MLE). For example, based on our experience at Delhi, California, their 1 MGD capacity AIWPS® Facility cost less than half as much to build and operate while producing an equal or better effluent quality as compared with an equivalent capacity mechanical wastewater treatment plant. Also an AIWPS® Facility can be designed and constructed more quickly, can minimize greenhouse gas emissions, and produces no surplus primary or secondary sludge other than algal biomass, which is both valuable and non objectionable in odor or appearance.

TREATED WATER DISPOSAL AND REUSE

The AIWPS® Treatment Technology, combined with the STEG/STEP Collection Technology and effluent disposal through local reuse or gravity wells for groundwater recharge meets most of the objectives of the Basin Plan in a cost effective and sustainable process. Additional information regarding the selected alternative is provided in Section 10. Section 10 contains a discussion of the landscape plan for the Resource Park, the stormwater drainage plan, as well as the results of the initial geotechnical investigation of the Resource Park site. Additional geotechnical and hydrogeological investigations are currently underway and more details from both investigations will be furnished when available.

NITROGEN CONTROL

The Regional Water Quality Control Board, the Los Osos CSD, and the community are concerned with protecting and enhancing water quality both in the groundwater basin and in Morro Bay. One of the major objectives for elimination of septic tank effluent discharged into leach fields is to prevent increases in nitrate in the shallow groundwater that contains reduced forms of nitrogen, such as organic nitrogen and ammonium.

Nitrate and nitrite are formed through biochemical oxidation of ammonium. In a Warburg respirometer, an instrument which integrates and plots total oxygen uptake as a function of time, one can clearly see the two steps of oxidation: first, the oxidation of organic nitrogen compounds with release of ammonium, and second, oxidation of ammonium to nitrite and nitrate. Nitrite does not accumulate since it is quite unstable and rarely reaches significant concentrations if free molecular oxygen is present. Microorganisms in soils which are rich in organic matter will reduce nitrate to nitrogen gas. However, the conversion of ammonium to nitrate may be inhibited by a lack of available oxygen in the organic soil. Poor soils that are not rich in organic matter, such as those in the ancient sand dunes of Los Osos, are likely to be slow in converting ammonium to nitrite and nitrate due to lack of the necessary microbes. However, the scientists conducting the Los Osos/Baywood Park soil and groundwater nitrogen study (1994) obtained evidence that septic tank leachate ammonium underwent both nitrification and denitrification in a vertical distance of only 15 feet below the bottom of a leach pit indicating that the normal organisms for microbiological transformation of nitrogen are present in all soils where substrates are available (Waksman and Starkey, 1947).

MODIFIED LUDZACK-ETTINGER PROCESS

In the modified Ludzack-Ettinger (MLE) sequencing batch reactor process, there are two mechanisms for removing nitrogen, 1) uptake by the microorganisms and their subsequent removal as sludge, and 2) oxidation to nitrate followed by anoxic denitrification. Considerable energy is required in the MLE process since sufficient oxygen must be provided to satisfy the biochemical oxygen demand (BOD) of the wastewater and to release ammonium. The ammonium must be oxidized to nitrite and nitrate and then be denitrified in a zone made anoxic by concentrated carbonaceous organics deprived of free molecular oxygen. The anoxic organisms have the necessary enzymatic system to decompose nitrate to oxygen and nitrogen gas. The oxygen is used for cell metabolism and the nitrogen gas eventually returns to the atmosphere. Because the denitrification step is at the end of the MLE process, absence of sufficient organic matter to sustain anoxia will result in nitrate being present in the effluent. To remedy this eventuality there must be provision for supplementary organic matter to cause microbes to lower the oxidation-reduction potential to a point that denitrification is induced. Methanol is most often used for this purpose. Systems of this type are vulnerable to odor and must be largely enclosed.

NITROGEN REMOVAL IN AIWPS® FACILITIES

The primary objective of the AIWPS® Facility design is to minimize the total nitrogen entering the groundwater. In the AIWPS® Technology alternative there are more mechanisms for removing nitrogen from wastewater than in the MLE process. The first is a process common to intensely anoxic zones called heterotrophic nitrification-denitrification in which organic nitrogen is apparently converted to hydroxylamine in route to denitrification. The biochemical pathway for this reaction is not well characterized, but the fact of its occurrence has been known and described by limnologists for more than a century (Hutchinson, 1957). The necessary environment for this step is provided by physically separating the influent zone from oxygen intrusion and introducing the septic tank effluent into the anoxic zone. Septage will be an important source of anoxic organics which when added to the STEG/STEP effluents that are also intensely anoxic, will provide the anoxia needed to convert some organic nitrogen to nitrogen gas by heterotrophic nitrification-denitrification. Ammonium is also formed from organic nitrogen by heterotrophs and enters the aerobic section of the Advanced Facultative Pond (AFP). Aerobic conditions are assured by surface aeration using aspirating-type aerators to assure odor control as well as to produce aeration solids and to convert residual ammonium to nitrate. This nitrate will be denitrifed using anoxic aeration solids that settle into a second anoxic fermentation cell. Aside from the nitrogen incorporated in the anoxic microbes which will tend to stay at the bottom of the AFPs, there will be more ammonium released from resistant organics and carried into the upper aerobic zone where the ammonium will be absorbed by growing microalgae. Such algae generally contain 5% to 10% nitrogen. Algal uptake and harvesting is the third mechanism for nitrogen removal. To assure a maximum crop of algae and maximum ammonium uptake, algae are grown in systems optimized for algal production called High Rate Ponds (HRPs). These gently mixed raceways select for and aid in the flocculation of larger, more settleable algal species that settle readily once they enter the quiescent Algae Settling Ponds (ASPs) which are specially designed to improve algal sedimentation and to facilitate algal harvest. Settled algae is periodically removed from the bottom of the ASPs and pumped in a 3% solids slurry to underdrained algae drying beds where they quickly dry and form "green chips" that are easily removable from the drying beds. There is no odor associated with algal concentrate when quickly dried. Effluent from the ASPs will still contain suspended smaller algae and some ammonium. This will be subjected to primary dissolved air flotation (DAF) which will remove virtually all microalgae. Since microalgae are rich in nitrogen, their removal as DAF float is a third nitrogen removal mechanism. Primary DAF effluent will be discharged into a second HRP where any residual ammonium is taken up by algae. Finally algae along with any suspended organic nitrogen are removed by the second DAF followed by sand filtration. Because bicarbonate will be in very short supply in the second HRP, and since pH is in part determined by the ratio of carbonate (CO_3^{2-}) to bicarbonate (HCO_3^-), the pH in the second HRP will be greater than 9.5. Above pH 9.5, ammonium (NH_4^+) transforms into ammonia (NH_3), a gas which normally escapes into the air from the thin layer of water on the HRP paddle wheel blades. Each paddle wheel exposes more than 20 acres of blade surface to the atmosphere each day assuring ammonia outgassing when it is present in the liquid. Ammonia outgassing from the HRPs is the fourth mechanism of nitrogen elimination in the AIWPS® Process.

To summarize, the AIWPS® Technology eliminates nitrogen by four mechanisms: heterotrophic nitrification-denitrification; by ordinary nitrification-denitrification, by algal uptake and subsequent removal, and by ammonia release through outgassing under elevated pH conditions due to removal of CO_2 by algal photosynthesis.

WASTE COMPOSITION

The quantity of wastewater at build-out will consist of about 1 million gallons per day (MGD) of septic tank effluent and 6,000 gallons per day of septage. It is expected that septage will be pumped only 250 days per year so that the mean septage addition will be 250 ÷ 365 x 6,000 gal/day = 4,100 gallons per day on average. In Table 8-2, using information provided in the 1984 EPA Handbook of Septage Treatment and Disposal, we estimate the composition of the septage addition after dilution in 1 MGD of septic tank effluent for 6,000 gal/day of septage for 250 days and for 4,100 gal/day for 365 days. The increments are obviously significant particularly with respect to total volatile solids and BOD. The increments for nitrogen are very small, only 2.85 mg/L for Kjeldahl nitrogen including 0.61 mg/L for ammonium nitrogen. Similar minor increments are indicated for phosphorus and alkalinity. Table 8-2 shows projected STEG/STEP effluent constituents as presented in the 1983 Water Pollution Control Federation Manual of Practice FD-11 and shows design septic tank effluent constituents with septage increments added (WPCF, 1983, p. 93).

Of special interest in Table 8-1 are the values for total nitrogen, 41.7 mg/L: including ammonia nitrogen, 28.6 mg/L as N; organic nitrogen, 12.7 mg/L as N; and nitrate nitrogen, 0.4 mg/L as N. These levels of nitrogen are less than the values usually found in raw domestic sewage, reflecting the suspended solids removal and facultative decomposition that occurs in septic tanks. The oxidation-reduction levels attained in septic tanks are not likely to be sufficiently low for heterotrophic nitrification-denitrification, but the absence of nitrate as reported in Table 8-1 is testimony to the fact that almost all nitrate that may enter a septic tank is denitrified. On the other hand, septic tank effluent may have very small amounts of nitrate from cleaning compounds or groundwater I&I or both.

since when does nitrate enter tank?

Table 8-1. STEG/STEP Effluent Characteristics.

Parameter	Units	Weighted Average[1]	Design Septic Tank Effluent[2]	Design Septic Tank Effluent+ Septage
Flow	gal/capita/day	49	65	65
BOD_5	mg/L	142	107	135
BOD_{ult}	mg/L	237	179	225
COD	mg/L	289	218	280
pH	–	6.9	6.9	6.8
DO	mg/L	0.3	0.4	0.2
Total Solids	mg/L	376	283	447
Total Suspended Solids	mg/L	54	41	103
Volatile Suspended Solids	mg/L	37	28	69.1
Total Dissolved Solids	mg/L	260	195	255
Total Sulfides	mg/L	2.0	1.5	3.5[4]
Total Nitrogen	mg/L	**38**	35.5	41.7
Ammonium-N	mg/L	**31**	28	28.6
Organic-N	mg/L	**8.25**	10.4	12.7
Nitrate-N	mg/L	**0.42**	0.4	0.4[3]
Phosphorus	mg/L	**5.9**	4.05	5.05
Alkalinity	mg/L as $CaCO_3$	225	176	180
Grease	mg/L	39.0	30	62.9

[1] Water Pollution Control Federation. (1986). Note: These composited septic tank effluent data come from Bend, Oregon; Glide, Oregon; Manila, California; and Madison, Wisconsin, all locations that have higher annual rainfall than does Los Osos. There were no weighted averages for total nitrogen, nitrogen species, and phosphorus; **average nitrogen and phosphorus values for Los Osos septic tank effluent were taken from Brown & Caldwell (1983)**.

[2] The dilution is 49 gpd ÷ 65 gpd = 0.75 is the dilution factor.

[3] Nitrate is not likely to be found in septage.

[4] Meisner, (1979).

Table 8-2. The incremental influence of septage on Los Osos wastewater concentrations of major parameters.

Parameter	Design Values for Septage[1] (mg/L)	Daily Input (mg/d)	Daily Increase (mg/L)	Yearly Average Concentration (mg/L)
Total Solids	40,000	9.1×10^8	240	164
Total Volatile Solids	25,000	5.7×10^8	150	102.7
Total Suspended Solids	15,000	3.4×10^8	90	61.6
Volatile Suspended Solids	10,000	2.26×10^8	60	41.1
Biochemical Oxygen Demand (BOD_5)	7,000	1.59×10^8	42	28.8
Ultimate Biochemical Oxygen Demand (BOD_{ult})	11,200	2.54×10^8	67	45.9
Chemical Oxygen Demand	15,000	3.4×10^8	90	61.6
Total Kjeldahl Nitrogen	700	1.58×10^7	4.17	2.9
Ammonium-N	150	3.4×10^6	0.90	0.6
Organic-N	550	1.25×10^7	3.31	2.26
Total Phosphorus	250	5.67×10^6	1.5	1.0
Alkalinity (as $CaCO_3$)	1,000	2.26×10^7	6.0	4.1
Grease	8,000	1.81×10^8	48	32.9
pH	6.0			
LAS	150	3.4×10^6	0.89	0.6
Fixed solids	15,000	3.4×10^8	88.5	60.6

[1]U.S. EPA (1984).

Notes: Septic tank effluent design flow: 1.0 MGD = 3.78×10^6 L/d.
Septage flow: 6,000 gpd x 3.78 L/gal = 22,680 L/d.
Septage pumped 250 days per year; 250/365 = 0.685 dilution factor.
Nitrate is not likely to be found in septage, so TKN will be roughly equivalent to TN.

The anoxic portion of the AIWPS® Facility will require some time to come to equilibrium, so heterotrophic nitrification-denitrification will not start at once. On the other hand, because of supplementary aeration, there will be early conversion of organic nitrogen to ammonium and conversion of ammonium to nitrate. But because of the denitrifying zone, the effluent from the AFPs to the HRPs are expected to be denitrified prior to entering the HRP. Algae contain 8% to 10% nitrogen, so a light-limited algae culture with a concentration of 120 mg/L will usually contain 10 to 12 mg/L of nitrogen in algal cells which will be removed from the water. The second HRP should remove about the same amount of nitrogen if that much nitrogen is present to be removed.

Table 8-3 shows the progression of nitrogen elimination as wastewater moves through the AIWPS® Facility. These values are annual averages. During three months of winter (December, January, and February), effluent from the second DAF may exceed 6 mg/L of total nitrogen as N but should not exceed 7 mg/L. Concerning our assumption of better nitrogen removal after one year, it should be noted that the AIWPS® Wastewater Treatment and Water Purification Facility, like all new wastewater treatment plants, must come to equilibrium.

Table 8-3. Expected annual mean total nitrogen concentrations in each element of the AIWPS® Facility.

Element	Start-up Year	After Year 1
Influent	38	40
Fermentation Cell 1 effluent	36	35
Fermentation Cell 2 effluent	35	30
High Rate Pond 1 effluent	32	29
Algae Settling Pond 1	28	26
Dissolved Air Flotation Unit 1 effluent	23	19
High Rate Pond 2 effluent	19	18
Algae Settling Pond 2	16	15
Dissolved Air Flotation Unit 2 effluent	9	8
Sand Filter effluent	7	6

Microorganisms in the Fermentation Cells that transform nitrogen under anaerobic conditions grow slowly but live longer than many associated anaerobes. So several months are therefore required for these microorganisms to initiate significant nitrate reduction.

One of the pitfalls when nitrogen removal is nearly complete is the appearance of nitrogen-fixing blue-green algae (cyanobacteria). The occurrence of nitrogen fixing cyanobacteria is stimulated by the absence of fixed nitrogen and the presence of phosphorus in the water.

Phosphorus is readily removed by alum coagulation and flotation in the DAF units, so stoichiometric amounts of alum will be applied along with a biodegradable polymer to assure an effluent very low in phosphorus and hence not likely to encourage the growth of blue-green algae. Since alum is normally used in drinking water treatment and is present in all clays and most soils (the lithosphere is 17% aluminum), its residual is not likely to pose a hazard in the disposal of the final treated effluent.

WELL WATER QUALITY

The quality of water used in a community has an important influence on the effectiveness of wastewater treatment. Table 1.1. shows the quantity and quality of three main sources of groundwater used in Los Osos. Both the Los Osos CSD and Cal Cities Water Company are providing total dissolved solids of 295 mg/L and 162 mg/L respectively, well below the American Public Health Association (APHA) and U.S. EPA guideline maximum ideal of 500 mg/L. At 1,800 mg/L, S & T Mutual Water Company is providing water with more than three times the recommended TDS. This water should not be harvested.

One way of visualizing water quality is to prepare bar graphs based on the reported chemical concentration modified in terms of milliequivalents (1/1,000th equivalents or meq) of combining power. For example, for cations we have sodium, manganese, and calcium. Magnesium with an atomic weight of 24 g/mole and a valence of +2 equivalents/mole, has an equivalent weight of 12 g/eq or 12 mg/meq. Cal Cities water with a magnesium concentration of 19.7 mg/L contains 19.7 mg/L ÷ 12 mg/meq = 1.64 meq/L Mg^{2+}. Whereas, the Los Osos CSD water has a magnesium concentration of 29 mg/L and contains 29 mg/L ÷ 12 mg/meq = 2.42 meq/L Mg^{2+}. In the case of sodium, which has an atomic weight of 23 g/mole and a combining power of only +1, the equivalent weight is 23 g/eq or 23 mg/meq. Thus, the Los Osos CSD water contains 35.9 mg/L ÷ 23 mg/meq = 1.56 meq/L of Na^{+}, and Cal Cities water contains 34.8 mg/L ÷ 23 mg/meq = 1.51 meq/L of Na^+. The other main cation in natural waters is calcium, Ca^{2+}. The atomic weight of Ca^{2+} is 40 g/mole, so its equivalent weight is 20 mg/meq. Therefore, the Los Osos CSD water with a Ca^{2+} concentration of 31.5 mg/L contains 31.5 mg/L ÷ 20 mg/meq = 1.57 meq/L, and Cal Cities water has 24.7 mg/L ÷ 20 mg/meq = 1.24 meq/L Ca^{2+}. The sum of cation equivalents for the Los Osos CSD water: Mg^{2+} 2.42 meq/L, Na^+ 1.56 meq/L, and Ca^{2+} 1.57 meq/L = 5.55 meq/L of cations. For anions, we have chloride, sulfate, and alkalinity; the latter type determined by the pH. The Los Osos CSD has 41.1 mg/L Cl^- with a combining power of +1 and an atomic weight of 35.5 g/mole. The equivalent weight is 41.1 mg/L ÷ 35.5 mg/meq = 1.15 meq/L. The Los Osos CSD sulfate concentration is 21 mg/L. Sulfate is a molecule, SO_4^{2+}, with a molecular weight of 96 g/mole and a valence of -2, so its equivalent weight is 96 ÷ 2 = 48 mg/meq, and for Los Osos CSD water, the sulfate equivalent concentration is 21 mg/L ÷ 48 mg/meq = 0.44 mg/meq. The Los Osos CSD alkalinity is reported as 200 mg/L as $CaCO_3$, and the pH is 7.44. So some of the alkalinity may be H_2CO_3, but we will assume it is all HCO_3^-. The molecular weight of $CaCO_3$ is 40 + 12 + 48 = 100 g/mole and with a combining power of -2, its equivalent weight is 100 g/mole ÷ 2 eq/mole = 50 g/eq or 50 mg/meq. Accordingly, the alkalinity is 200 mg/L ÷ 50 mg/meq = 4 meq/L. The total cations are 5.55 meq/L and the total anions are 1.15 + 0.44 + 4 = 5.59 meq/L, so the water is short in cations by 5.59 - 5.55 = 0.04 meq/L. This is too small a value to plot and may be the result of normal analytical error, but it also may indicate another cation of very low concentration is lacking in the analyses.

In analyzing the Cal Cities water, we see no report of alkalinity so we will determine its probable concentration using the ion balance concept. Fortunately, we do have concentration for the main cations: sodium, magnesium and calcium. Sodium is 34.8 mg/L; magnesium is 19.7 mg/L; and calcium is 24.7 mg/L. The major anions present are chloride at 65.80 mg/L and sulfate at 12.2 mg/L. We will need to determine alkalinity by difference from the cations:

Sodium: 34.8 mg/L ÷ 23 mg/mmole = 1.51 mmole/L;
Magnesium: 19.7 mg/L ÷ 12 mg/mmole = 1.64 mmole/L, and;
Calcium: 24.7 mg/L ÷ 20 mg/mmole = 1.51 mmole/L

The total is 1.51 + 1.64 + 1.51 = 4.66 mmole/L. Since the anions are chloride 65.8 mg/L ÷ 35.5 mg/meq = 1.85 meq/L and sulfate 12.2 mg/L ÷ 48 mg/meq = 0.254 meq/L, their sum is 1.85 + 0.254 = 2.10 mg/meq, so the difference between cations and anions is 4.663 - 2.10 = 2.55 mg/meq. This is likely to be the equivalent meq of alkalinity.

S & T Mutual water has the following concentrations:

Sodium: 180 mg/L ÷ 23 mg/mmole = 7.82 mmole/L;
Magnesium: 160 mg/L ÷ 12 mg/mmole = 13.33 mmole/L, and;
Calcium: 180 mg/L ÷ 20 mg/mmole = 9.0 mmole/L.

These total to 30.15 meq of cations. The chloride concentration of 1100 mg/L ÷ 35.5 mg/mmole = 30.98 mmole/L, sulfate 63 mg/L ÷ 48 mg/meq = 1.312 meq/L, and the alkalinity concentration as $CaCO_3$ is 140 mg/L ÷ 50 mg/meq = 2.8 meq/L, so the cation sum = 30.15 mg/L and the anion sum = 30.98 + 1.312 + 2.8 = 35.09 meq/L. There is, accordingly, a 4 meq/L cation deficiency of 35.09 - 30.15 = 4.94 meq/L

It should be noted that Cal Cities has the most nitrate at 4.1 mg/L. Since the equivalent weight of NO_3 is 14 + 48 = 62 mg/meq with a valence of +1, 4.1 mg/L ÷ 62 mg/meq = 0.066 meq/L.

It is important to note that all of these waters are extremely low in sulfate and hence less prone to produce sulfide odors than higher sulfate waters. All Los Osos municipal waters have similar cationic compositions, but S & T water is unusual because of its high chloride composition and very low alkalinity. It has little buffer capacity. Because its total dissolved solids exceeds APHA standards by almost four fold, it probably should be managed separately from the other waters for disposal.

The other waters tend to be high in calcium and magnesium, the ions of "hardness". Some of the calcium will no doubt be precipitated as $CaCO_3$ in the High Rate Ponds. This should enhance algal separation in the Algae Settling Ponds, but it will likely impair UV disinfection by "clouding" the light covers. The above calculations are shown graphically in Figure 8-13 later in this section.

SEPTIC TANK NITROGEN

In septic tanks facultative heterotrophic bacteria convert proteins to amino acids and amino acids along with urea are converted to ammonium, the principle nitrogen source in STE. The transformation of ammonium in soils has been well known to microbiologists for more than 50 years (Stephenson, 1948; Waksman and Starkey, 1947; TAC, 1994). On larger lots, where soil saturation with water does not occur and free molecular O_2 is present, it is likely that the 30 - 35 mg/L of ammonium normally present in septic tank effluent will undergo nitrification by ubiquitous soil bacteria that, rather than using organic matter, will obtain their energy from oxidizing ammonium. One group of organism, *Nitrosomonas*, oxidizes ammonium to nitrite (NO_2-) and a second group, *Nitrobacter*, oxidizes nitrite to nitrate NO_3^-. *Nitrosomonas* functions best in the pH range 7.5 to 9.5, whereas *Nitrobacter* functions in the wide pH range 5.5 to 10.5. Both groups function well at very low levels of free molecular O_2. Some of the nitrogen and some ammonium is assimilated by the microbes themselves and the organic matter created by their growth along with organic residuals in soils undergo decomposition and serves as an energy source for denitrification. These anaerobic organisms obtain oxygen from nitrite and nitrate, thereby reducing nitrate to N_2 which eventually returns to the air.

There is thus a cascade of reactions which occurs in unsaturated soils directly below a leach field. Finally, as the residuals move downward and reach groundwater there is little of the original nitrogen remaining and that is likely locked into refractory organics. On the other hand, in soils saturated with water, the oxidation of ammonium is likely to be retarded in the same way as it is retarded within the septic tank itself - by the absence of free molecular oxygen. Later, likely at some point downstream, assuming the water is moving, sufficient oxygen may become available to produce nitrite and nitrate which in the presence of DO are conserved until conditions permit its biological transformation-for example the water is used in irrigation and nitrate is taken up by growing plants.

Because of these nitrogen transformations and consequent nitrogen removal, there is reasonable justification in not collecting septic tank effluent from large lots with leach-field bottoms separated from groundwater by at least 15 ft. The population to be collected by the STEG/STEP system includes almost the entire Prohibition Zone and will include two additional areas Redfield Woods with a projected population of 1,775 and Bayridge Estate with a projected population of 370. The entire collected population in the prohibition zone at buildout is then 12,463 plus 2,145 = 14,603. Because the projected population for the entire area is about 19,000, about 77 percent of the community will be collected at build-out. As stated above, the 23% not collected are from large lots which are likely to establish ammonia oxidation and nitrate reduction as a natural phenomenon such as that described by Stephenson (1948), Waksman & Starkey (1947), and the TAC (1994).

According to data published by the Water Pollution Control Federation (1983) and the EPA *Handbook of Septage Treatment and Disposal* (1984), effluents from septic average about

38 mg/L of total N. If the flow is 50 gal/day for the current population of about 15,000 discharging 50 gallons per day per person and assuming no losses, the N input to groundwater would be 38 mg/L x 8.34 x 0.75 MGD = 237 lbs per day or 86,755 lbs per year as N (39,435 kg/yr as N). Because all of this nitrogen goes into the shallow groundwater, it is clear why there has been a continuous increase in total N in the shallow groundwater.

In Section 1, we have predicted the effect of the proposed wastewater project assuming that the septic tank effluent of 77% of the maximum buildout population will be collected, treated, and disposed by gravity wells, unless used for irrigation, when the proposed wastewater facilities are operational. Using the groundwater basin and fault information provided by The Morro Group and ~~our~~ independently calculated volume of the upper aquifer, we have predicted that ~~in~~ ?

Concerning minerals, it is worthwhile to examine some basic inputs as part of a study of mineral build-up resulting from recycle of treated water to the upper aquifer. According to studies of astronauts made by MIT, a 72 kg man excretes about 22.3 grams of mineral each day (Table 8.4) Women and children obviously excrete less. We estimate the average at near 15 grams per day for a whole population. At 50 gallons/cap/day, 189 liters/day, the incremental TDS would be 15,000 ÷ 189 = 79 mg/L. This is much below the usual salt increment which often is estimated at 200 mg/L to 300 mg/L. Increments above 79 mg/L are likely to be due to cleaning compounds, evaporation, etc., so that the increment may be more than three to four times the minerals added in feces, urine and perspiration. Nevertheless, minerals will build-up over time and eventually must be discharged as "blow down" to some point away from the aquifer in question.

Table 8-4. Mineral composition of human excreta expressed as milligrams per day for one 72-kg man (after Fritz Meisner, MIT, CELS, NASA, Jan. 10, 1979).

Ion	Feces	Urine	Sweat	Total
Ca	571.00	219.00	-	790.00
Cl	58.00	8,700.00	1,243.00	10,081.00
Mg	186.00	116.00	-	302.00
P	641.00	997.00	-	1,638.00
K	474.00	2,403.00	367.00	3,244.00
Na	121.00	4,089.00	839.00	5,049.00
S	119.00	1,154.00	-	1,273.00
Totals	2,170.00	17,639.00	2,449.00	22,377.00

AIWPS® TECHNOLOGY PERFORMANCE DATA

The following section presents water quality data demonstrating the performance of the AIWPS® Technology for secondary and tertiary wastewater treatment in terms of removal of Biochemical Oxygen Demand (BOD_5). Total Suspended Solids (TSS), nitrogen, phosphorus, turbidity, bacteria, and virus in Figures 8-2 through 8-10 respectively. Because of the great variability of influent BOD_5 concentrations in the Richmond sewage due to periods of rainfall during the two years of observations shown in Figure 8-2, we have used probability plots to illustrate the performance of the AIWPS® Technology in removing BOD over a two year period. As expected, the suspended solids in raw sewage are removed mainly in the fermentation cells, but to a lesser extent in the series of AFP, HRPs, and ASPs. The 50^{th} to 60^{th} percentiles approximate the BOD in septic tank effluent, much of which is

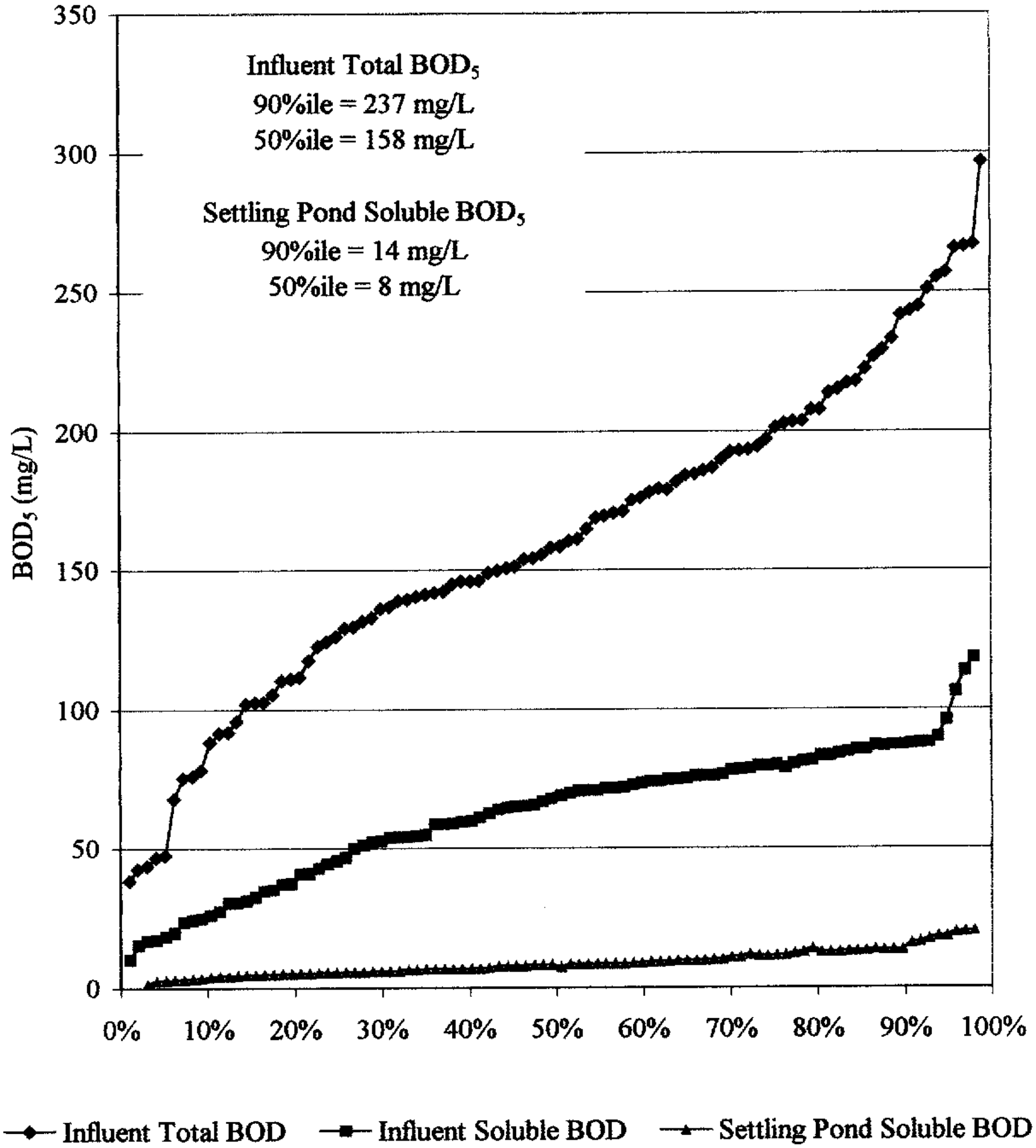


Figure 8-2. Probability plot of total and soluble BOD_5 concentrations at the AIWPS Demonstration Facility at Richmond, California, January 1997-February 1999.

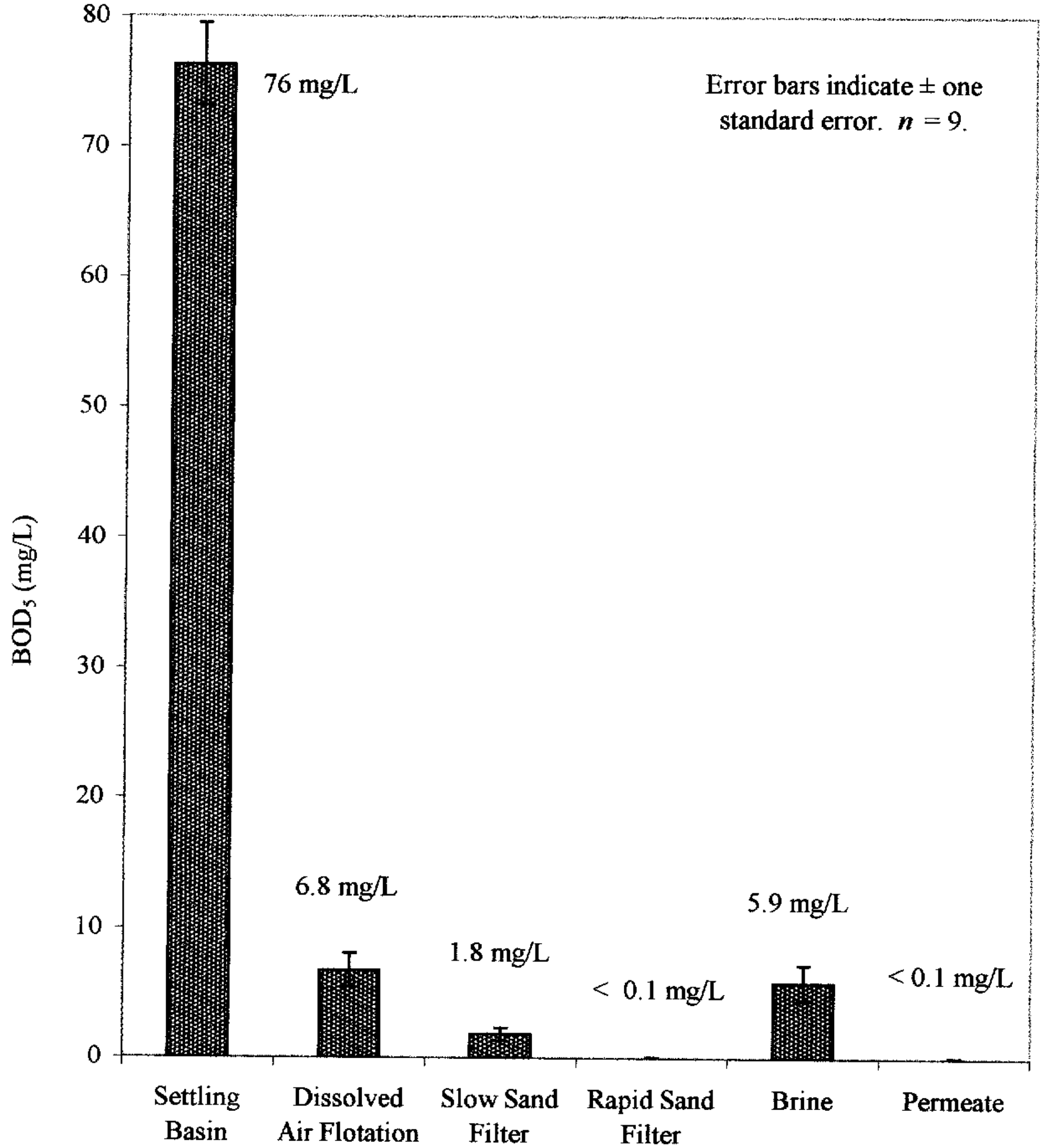


Figure 8-3. Total biochemical oxygen demand (BOD_5) at the AIWPS® Demostration Facility including RO at Richmond, California, February-May 1999.

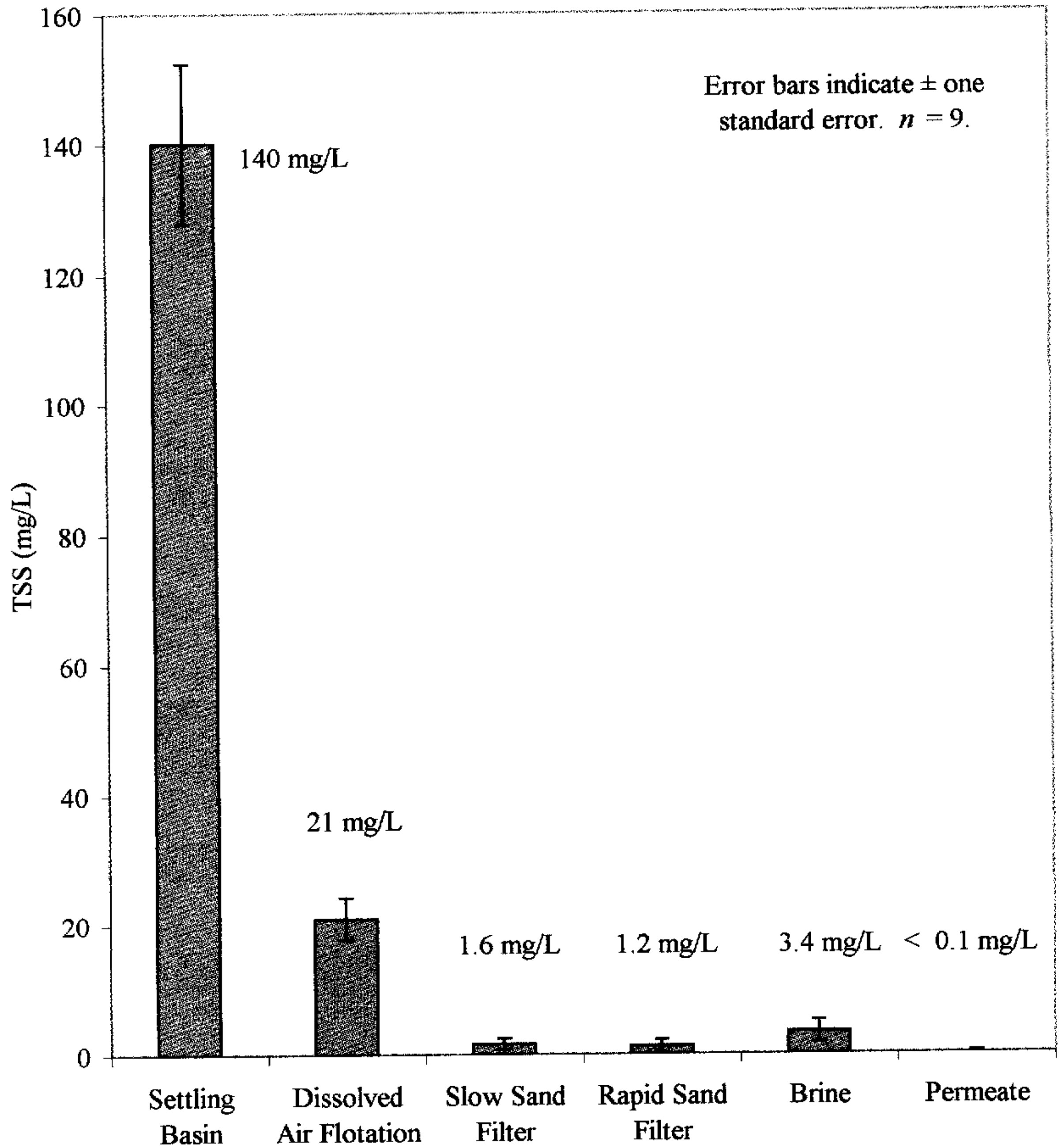


Figure 8-4. Mean total suspended solids (TSS) at the AIWPS® Demonstration Facility including RO at Richmond, California, February-May 1999.

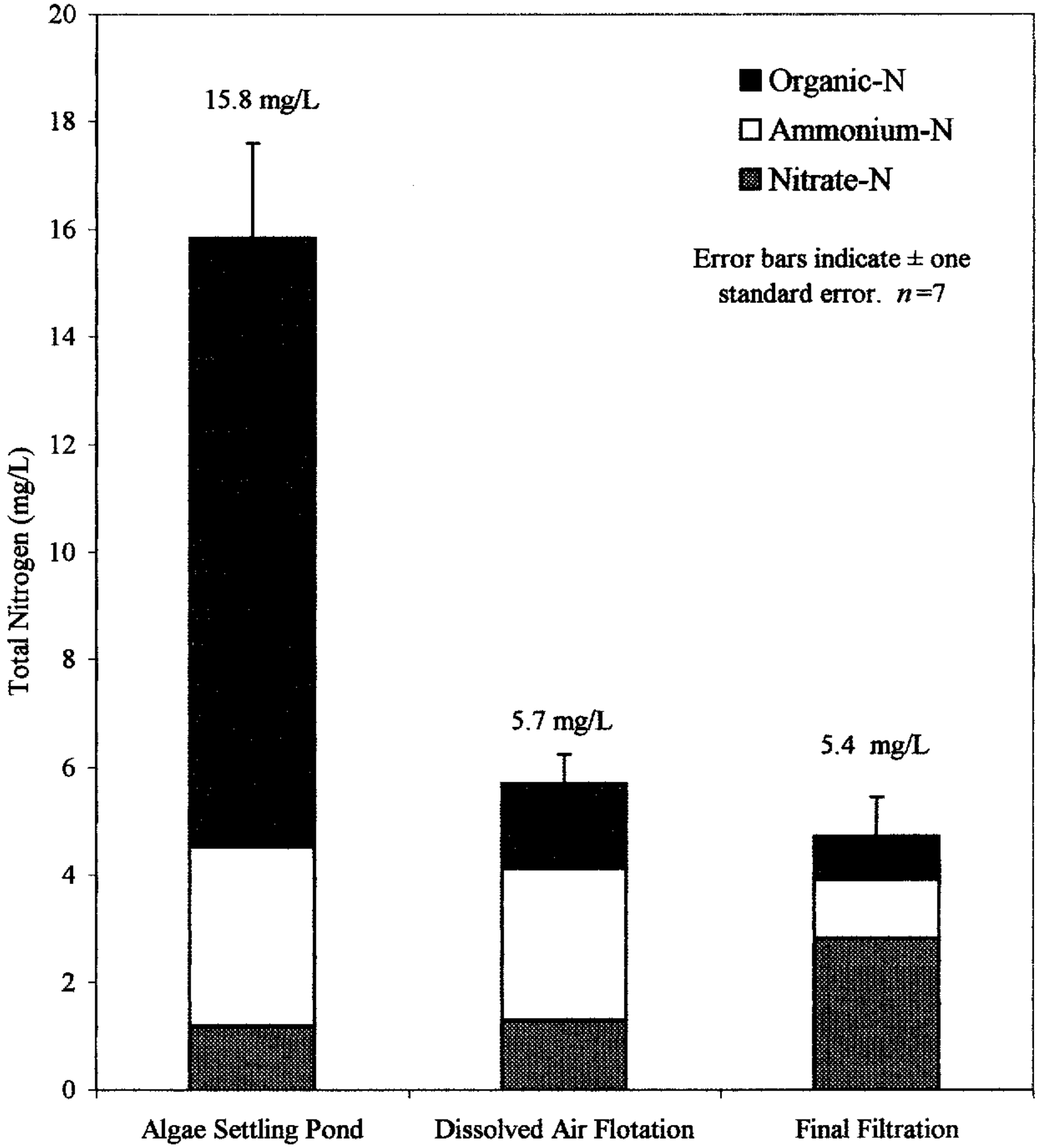


Figure 8-5. Mean effluent total nitrogen concentrations at the AIWPS® Demonstration Facility at Richmond, California, March-June 1999.

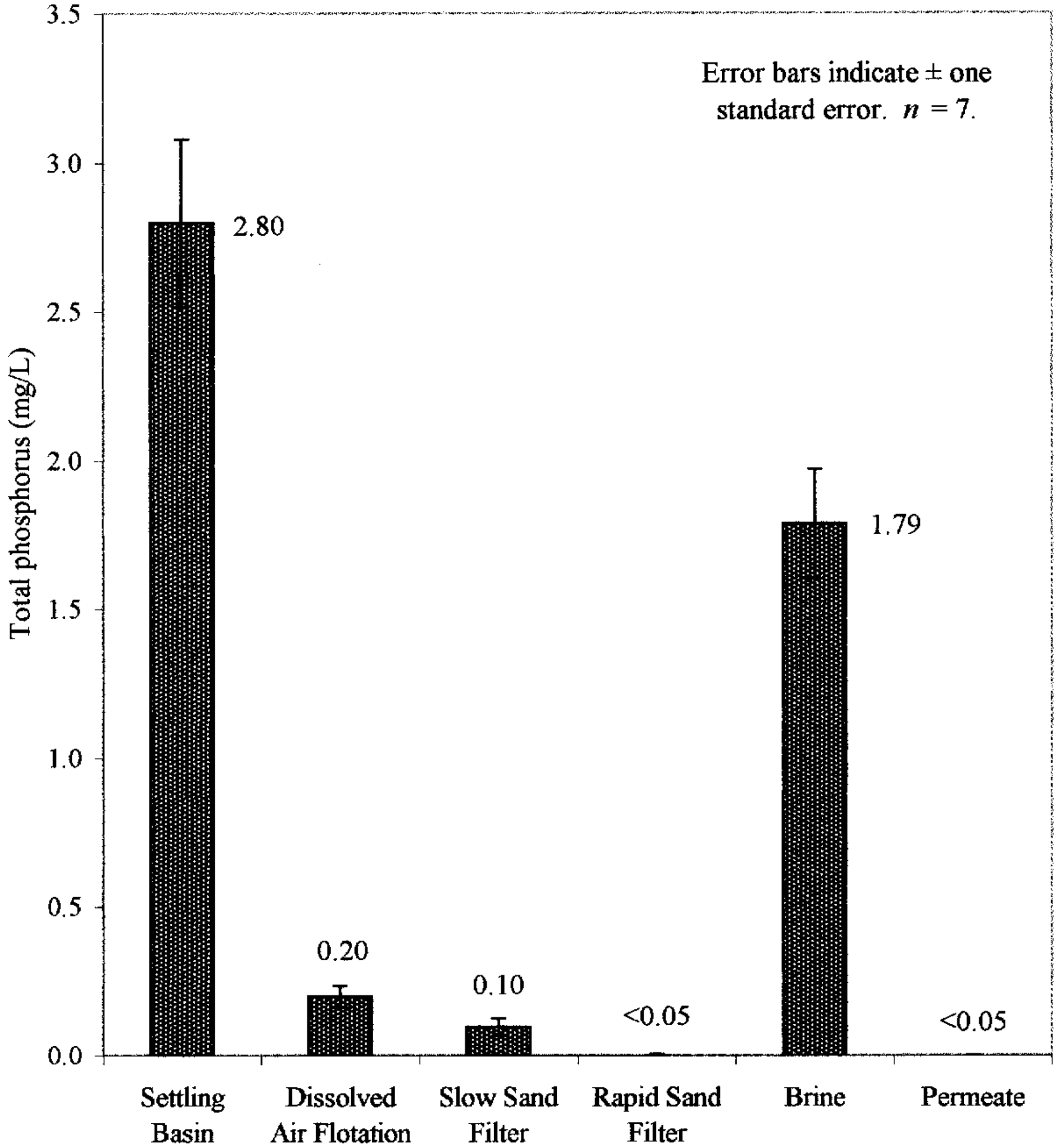


Figure 8-6. Mean effluent total phosphorus concentrations at the AIWPS® Demonstration Facility including RO at Richmond, California, March-May 1999.

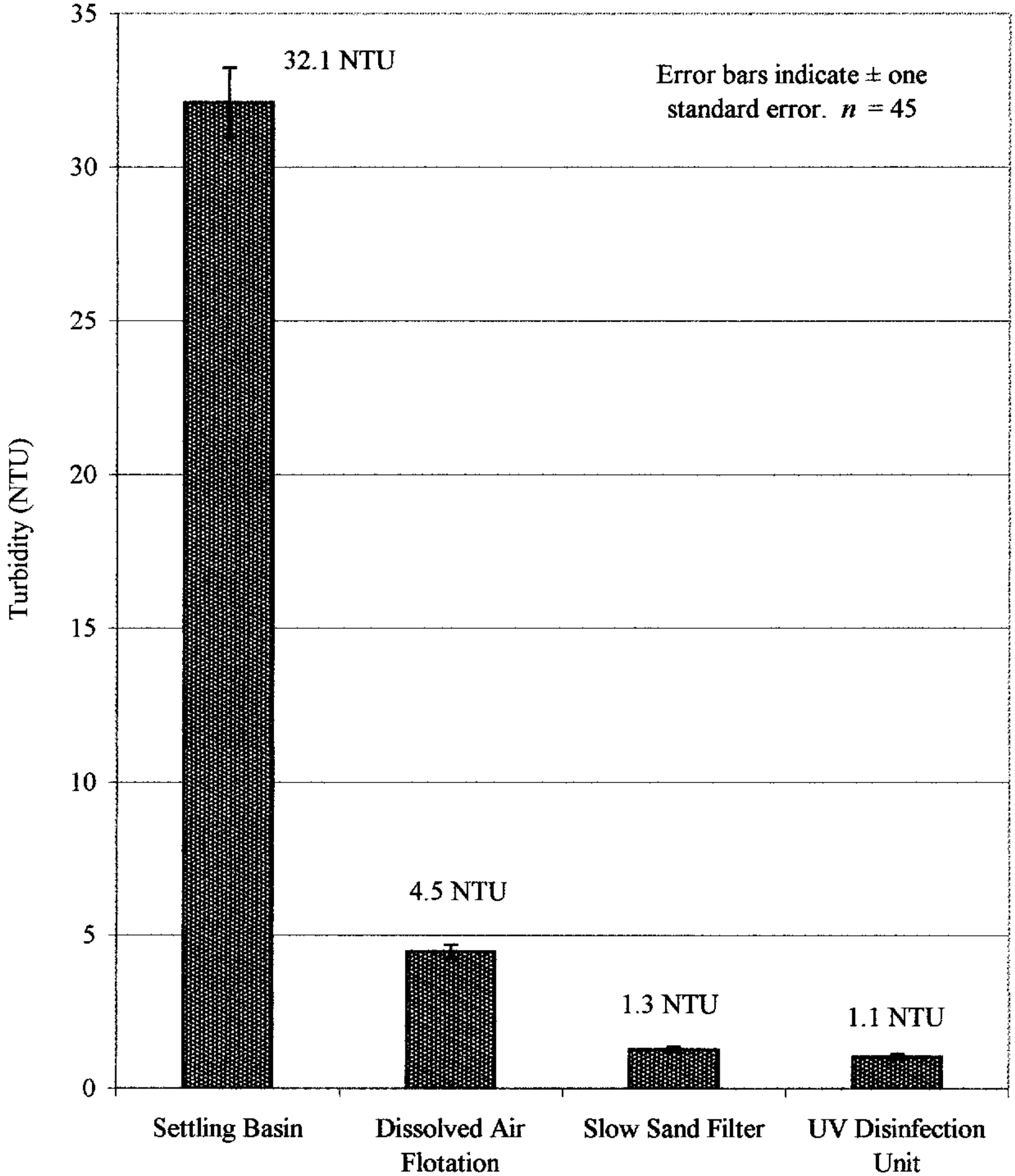


Figure 8-7. Mean effluent turbidity at the AIWPS® Demonstration Facility at Richmond, California, February-June 1999.

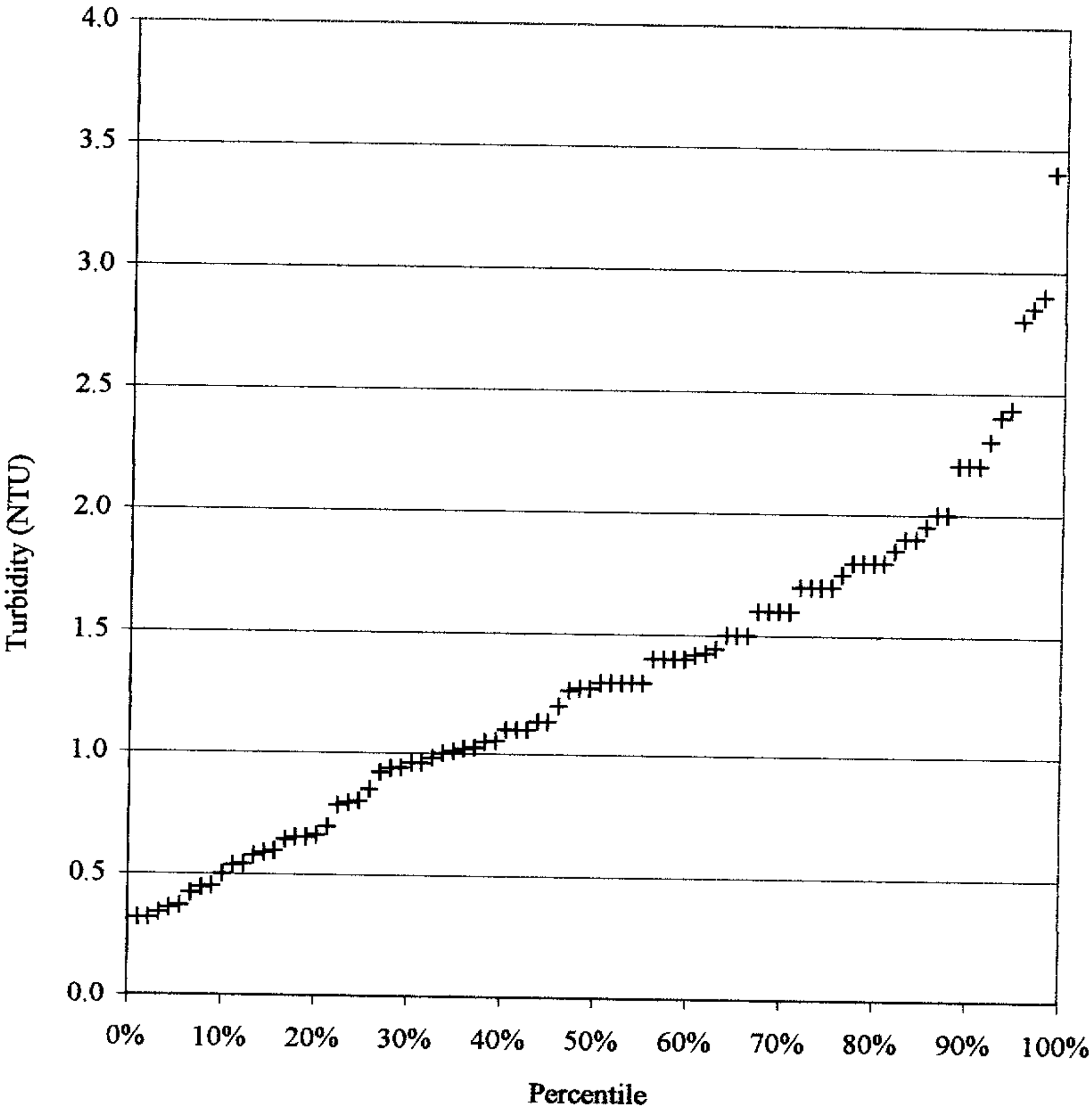


Figure 8-8. Slow sand filter effluent turbidity in daily grab samples at the AIWPS® Demonstration Facility at Richmond, California, February-June 1999.

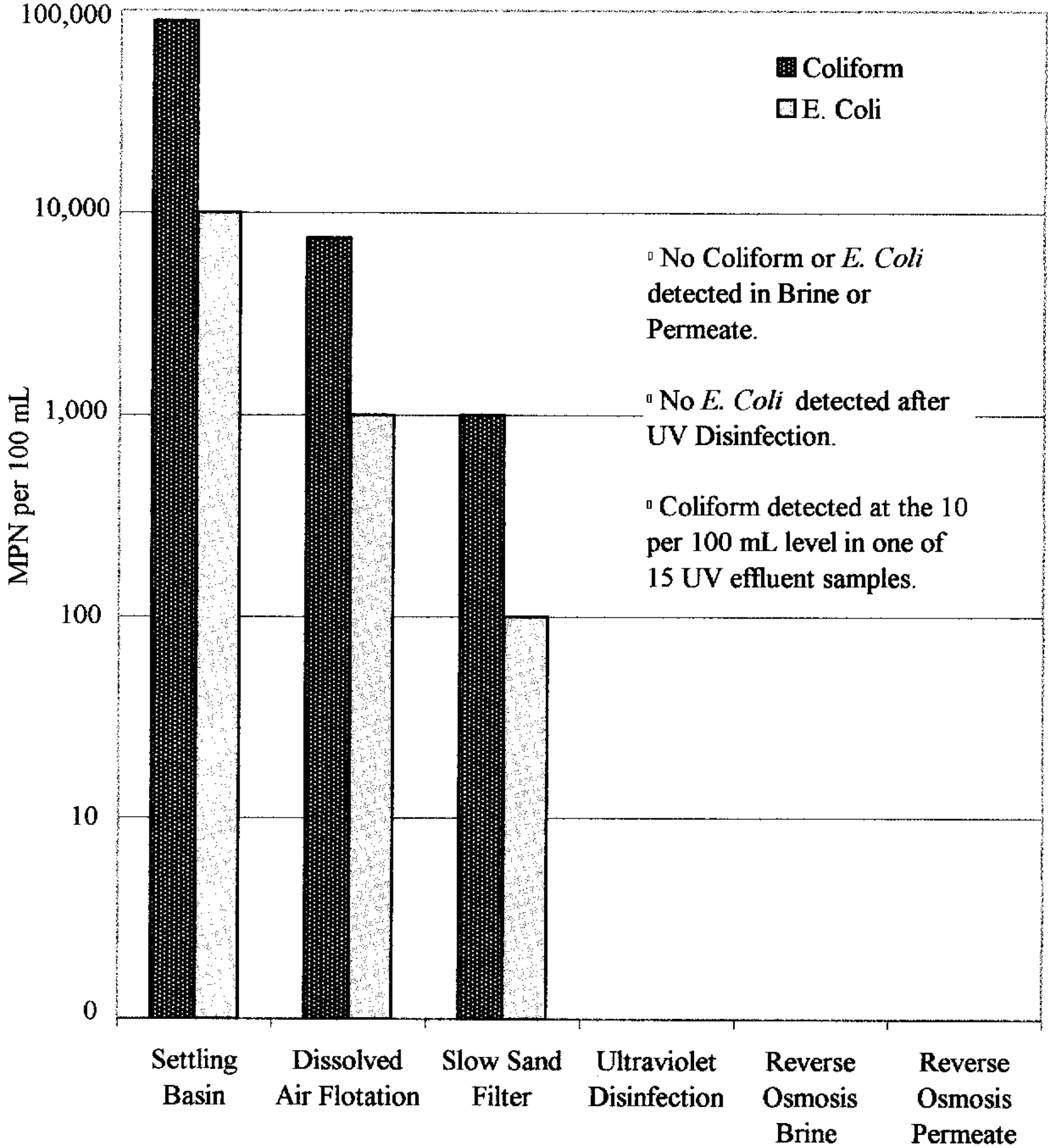


Figure 8-9. Median effluent total coliform and *E. coli* Most Probable Number (MPN) at the Richmond AIWPS® Demonstration Facility including RO at Richmond, California, March-April 1999.

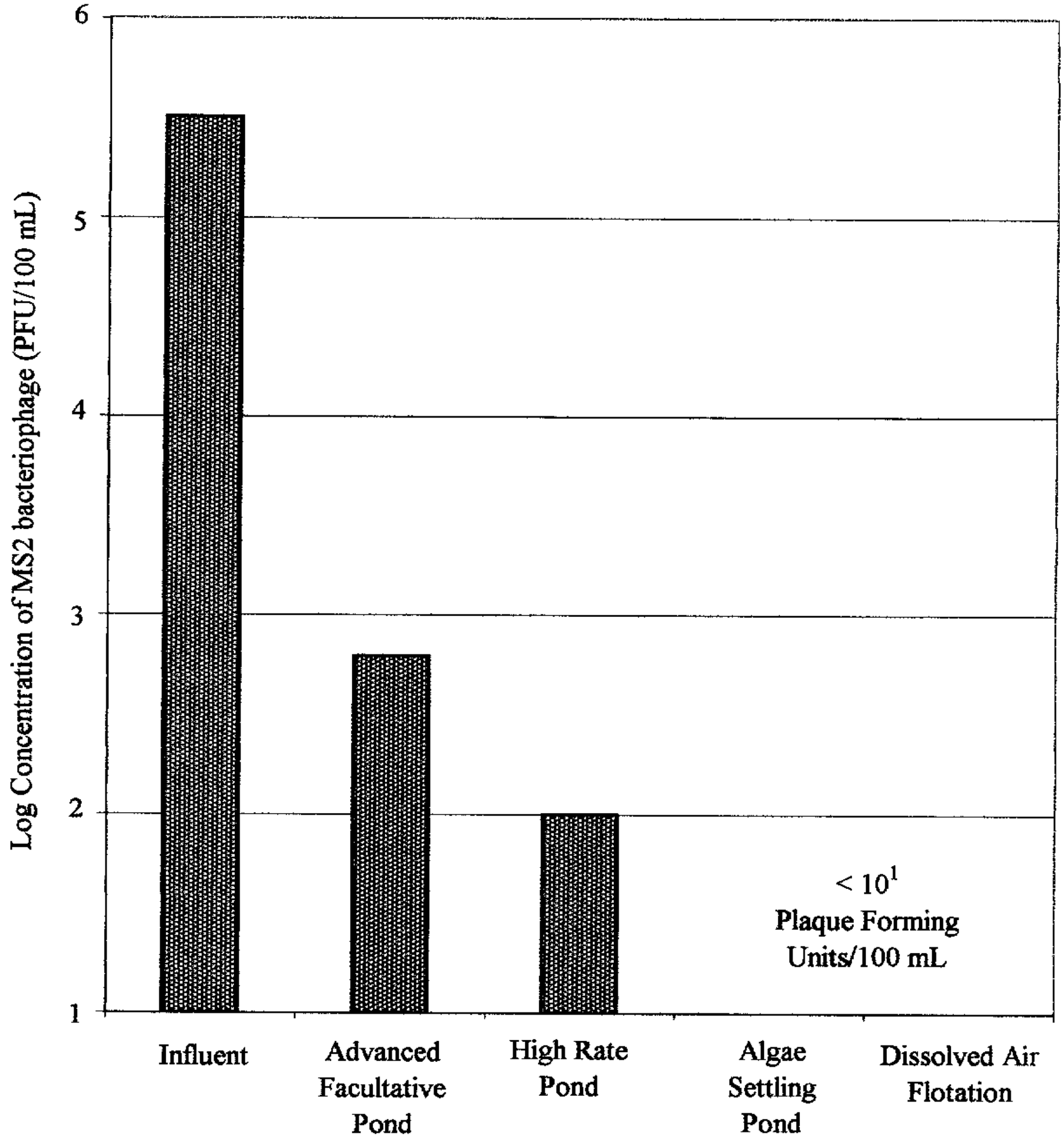


Figure 8-10. Effluent concentrations of the indicator virus MS2 bacteriophage at the AIWPS® Demonstration Facility on 28 June 1999.

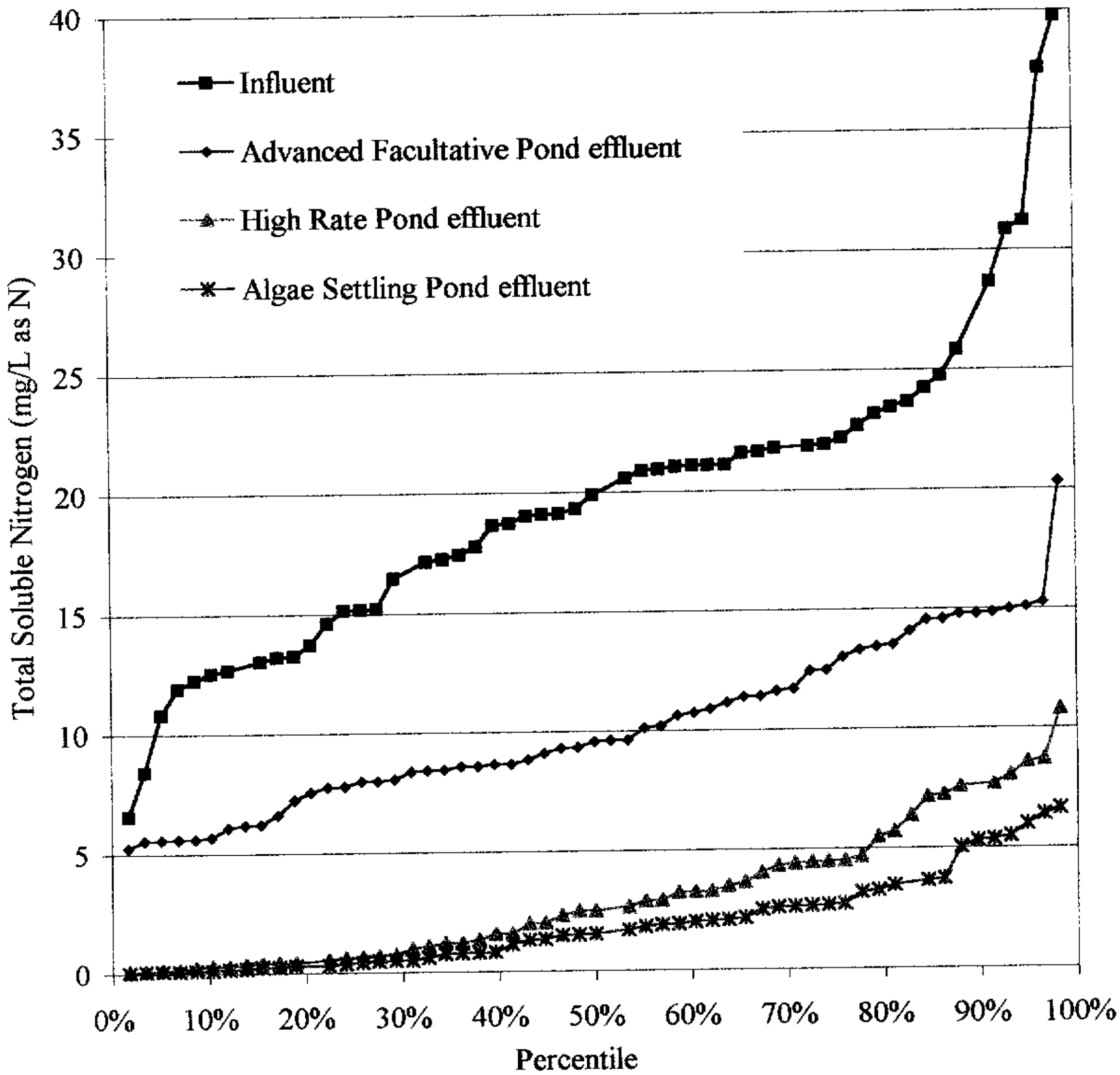


Figure 8-11. Probability plot of total soluble nitrogen including ammonium (NH_4^+), ammonia (NH_3), nitrate (NO_3^-), and nitrite (NO_2^-) in weekly 24-hour composite samples during January 30, 1997-May 7, 1998 at the AIWPS® Demonstration Facility at Richmond, California (with AFP, HRPs, and ASPs but without MP, DAF, filter and UV final disinfection).

colloidal (suspended bacteria and metal sulfides). As these move through the AIWPS® Process, they, along with newly formed suspended material (algae), are rendered insoluble and removable in the ASPs.

As shown in Figure 8-3, for Los Osos, we have added to the series of three units comprising a standard AIWPS® Facility, a second series applied to the ASP effluent: dissolved air flotation, filtration, and final disinfection. Figure 8-3 reflects our recent research on advanced tertiary treatment combined with Reverse Osmosis and demonstrates how the added steps of DAF and filtration to be used at Los Osos will bring the BOD_5 concentration to less than 2 mg/L.

Figure 8-4, also from our investigation of advanced tertiary treatment followed by RO, shows a case where ASP effluent was as high as 140 mg/L (algae), but after DAF was only 21 mg/L (mainly colloidal particles and bacteria) which were removed by the slow sand filter leaving less than 2 mg/L of TSS.

Figure 8-5 provides complete details concerning the three main nitrogen components–organic nitrogen, ammonium, and nitrate. Most of the organic nitrogen is in suspended algae which after DAF are removed to less than 2 mg/L while ammonium and nitrate comprise the remainder; note that the sum is less than 6 mg/L. After sand filtration organic N concentrations (primarily algae) were less than 1 mg/L, and within the slow sand filter 2 mg/L of ammonium was converted to nitrate. For this reason, we intend to use rapid sand filters at Los Osos, thus avoiding nitrate production and likely bringing the total N levels to less than 5 mg/L.

Although phosphorus was not included in the draft discharge requirements prepared for the previous County wastewater project, which may apply to the wastewater project proposed soluble nitrogen concentrations as N found as wastewater moves through the sequence of reactors in the standard AIWPS®Facility. The indication is that without the added tertiary treatment steps that are proposed for the Los Osos AIWPS® Facility, effluents contained soluble N concentrations below 5 mg/L more than 85% of the time. We have added DAF, filtration, and disinfection to this treatment train as insurance that only very low levels of any pollutant will be in the final effluent of the proposed AIWPS® Facility.

raw, not septic eff + septage

While it should be emphasized that our AIWPS®Demonstration Facility at Richmond is a one-acre outdoor unit treating 25,000 gallons per day of raw sewage from the City of Richmond, and that it is subject to the flow variability, rainfall, and contamination (by ducks, geese, atmospheric depositions, etc.) of any real facility, we add proof of concept with the data shown in Figure 8-12 for the much larger AIWPS® Facility located in St. Helena, California, that we have studied extensively over the years, is presented for added confirmation of the principles described. As may be seen, all of the data over 50 years of studies show that the AIWPS® Technology does not naturally produce nitrate and has the inherent capability to render most all nitrogen in wastewater to insoluble, volatile, and removable forms. DAF and filtration assure that these removals are finally and dependably attained.

We have added significant redundancy in the preliminary design of the AIWPS® Facility proposed for Los Osos so that even if per capita flows approach 100 gallons per capita per day, the proposed AIWPS® Facility would still attain or exceed the objectives outlined in the tentative discharge requirements.

SECTION 9
PUBLIC PARTICIPATION

INTRODUCTION

This section will describe the history of public participation associated with the Wastewater Project in the community of Los Osos.

Very few, if any, communities have demonstrated the high level of informed public participation as has been seen in Los Osos with respect to the Wastewater Project. Over the last several years, professional individuals within the community banded together to developed a viable alternative plan, and then successfully presented their ideas to the Los Osos residents.

BACKGROUND

The population of Los Osos has grown from around 600 in 1950 to nearly 15,000 today. Throughout the community, the method of wastewater disposal has been and remains by onsite systems, primarily septic tanks and leach fields or seepage pits. In the late 1970's, the RWQCB observed high nitrate levels in shallow groundwater monitoring wells and concluded that the nitrate levels in the groundwater were increasing with population and were a result of the increasing numbers of onsite wastewater systems.

On September 16, 1983, the RWQCB adopted Resolution No. 83-13, which imposed a prohibition against individual wastewater treatment system discharges. Resolution 83-13 became fully effective on November 1, 1988, imposing a complete building moratorium in Los Osos until a community-wide system is in place. The moratorium in Los Osos has resulted in the following conditions:

- one-fourth of commercial and retail space is vacant;

- 76% of the working community commutes outside of Los Osos;
- businesses needing to expand are forced to leave the community;
- residents cannot even add "mother-in-law" units to their homes if needed to provide family member housing.

Los Osos residents have been and remain extremely anxious to remedy the problems described above.

In response to Resolution No. 83-13, the County of San Luis Obispo implemented preliminary design of a system to provide wastewater collection and treatment within the County Service Area No. 9 (CSA 9). Over the next several years, the project designers evaluated various treatment and disposal schemes, with the final design being based on conventional collection, treatment, and disposal technologies. Throughout this period, various citizens groups formed by professionals from Los Osos, worked without remuneration toward the development of a wastewater project that would best serve the needs of the community, on several occasions in direct opposition to County plans.

As the County construction documents neared completion, its construction cost was estimated to be in excess of $70 million. The corresponding cost per household to finance the County project was estimated to be somewhere between $100 and $120 per month. With the belief that these anticipated costs were too expensive for many Los Osos residents and that proven alternative wastewater technology better fit Los Osos, a local group of concerned volunteer professionals organized in 1997 as the Solution Group and developed the *Los Osos/Baywood Park Comprehensive Resources Management Plan* (CRMP).

The CRMP was intended to accomplish the following:

- provide an economically feasible resolution to wastewater treatment in Los Osos,
- reduce total nitrogen content of treated wastewater effluent to a degree acceptable to the RWQCB,
- employ technologies which are compatible with the local community and local construction conditions; and where possible,
- incorporate provisions for meeting community development needs as a part of the wastewater treatment facility.

The project, envisioned in the CRMP, consisted of the following major components:

POND-TYPE TREATMENT SYSTEM.

The treatment technology presented in the CRMP is the Advanced Integrated Wastewater Pond Systems® Technology. The AIWPS® Technology a proprietary, pond-type biological treatment system, incorporating natural, less expensive processes to treat wastewater. This system has the potential of being less expensive to construct and operate than conventional treatment systems and is presently being used in many other communities around the world. By incorporating filtration and final disinfection, the AIWPS® Facility is will provide a very high quality of discharge effluent. The treatment ponds do not have an unpleasant odor, will be aesthetically pleasing, and are planned to be incorporated into a community park.

STEP/STEG COLLECTION SYSTEM

The existing septic tanks in the community were proposed to be left in place. In the areas of the community where the groundwater is high and soil column to the groundwater is inadequate to provide proper treatment, the effluent from the septic tanks was proposed to be collected and transported to the treatment plant. The collection system was proposed to be a combination of Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) system. These systems are smaller diameter lines than conventional collection systems and can be placed on flatter slopes and shallower depths since they do not carry solids. The result is substantial cost savings in the most expensive portion of a wastewater system.

SEPTIC SYSTEM MAINTENANCE AND MANAGEMENT PROGRAM

A septic tank maintenance and management program (SSMMP) was proposed to include the entire community within the urban reserve line established by the Estero Area Plan. The SSMMP is intended to provide inspection, maintenance, and repair of septic system components within the community. The SSMMP will also maintain the STEP/STEG system components.

The community of Los Osos voted in favor of formation of the Los Osos Community Services District (LOCSD) when a 75% voter turnout voted with an 87% approval rate.

RECENT HISTORY

The LOCSD began operation in January 1999. Since its inception, it has successfully assumed the operation of CSA No. 9 from the County. To accomplish this, the LOCSD has established an office in Los Osos, hired necessary staff, and begun handling all district billing and collection activities. Notable hires include a General Manager, a Utilities Director, a Billing Clerk, and three maintenance technicians.

With respect to the wastewater project, the LOCSD has also hired project management, wastewater treatment, environmental, and financial consultants to assist them in the development of a Draft Project Report, a comprehensive Facilities Plan, and construction documents for the Los Osos wastewater project.

The RWQCB is very interested in the progress of the proposed project and has established project milestones that the LOCSD intends to meet. The established milestones are:

Facility Plan Feasibility Study and Finance Plan to RWQCB	January 31, 2000
Proof of Circulation of Draft EIR to RWQCB	May 1, 2000
Final CEQA (EIR) Completion	July 30, 2000
SRF Facility Plan and Funding Plan to SWRCB	September 1, 2000
Proof of Assessment District Approval or Comparable Financing to RWQCB	October 15, 2000
Complete Construction Plans and Specs to RWQCB	May 31, 2001
Obtain County Use and Coastal Development Permits	July 30, 2001
Begin Construction	July 30, 2001
Complete Construction	July 30, 2003

The Facilities Plan is a detailed, technical report that includes a project report, technically describing the project, a draft revenue program, and water conservation plan, and the project environmental documents. A portion of the proposed financing for the project is presently planned to come from funds controlled by the SWRCB and the Final Project Report complete with Facilities Plan is an essential document in obtaining SWRCB approval.

The proposed project is currently on schedule and the LOCSD is firmly committed to meeting all of the milestones established by regulatory agencies.

Other recent public outreach-type activities have included meetings with the local State Senator and State Assemblyman to keep them informed as to the project progress as well as a meeting with SWRCB staff to clarify some project issues.

FUTURE PUBLIC OUTREACH

Outreach to the residents of Los Osos and other interested members of the public will be essential for the Los Osos wastewater to succeed. Development of a comprehensive revenue program to finance the project will likely require a successful vote of the public. In addition, the environmental review process will provide opportunity for intensive review by the public.

The LOCSD is currently in the process of developing a comprehensive voter and public outreach program for implementation in the near future. Their initial step will be to identify and assess the most effective methods of disseminating accurate project information. A Town Meeting has been scheduled for February 17, 2000 to present the finance plan and the estimated monthly assessments. A draft EIR hearing has been scheduled for June 1, 2000, and a final EIR hearing has been scheduled for July 20, 2000. Additional Town Meetings have been scheduled for July 20, 2000 and August 17, 2000 to address the Facilities Plan. Assessment hearings have been scheduled for February 17, 2000; April 20, 2000; June 1, 2000; and July 20, 2000, with Election Results by October 19, 2000.

Prompt and effective response to all comments received during the public review period of the environmental document will also be a very high priority for the Los Osos CSD.

DETAILED DESCRIPTION

As described above primarily in Sections 1 and 8, the selected Wastewater Project consists of STEG/STEP Collection Facilities; the AIWPS® Wastewater Treatment and Water Purification Facility and other developments at the Resource Park including the management of drainage; and, the wastewater disposal facilities proposed for either the Broderson site, the Morro Palisades site, or the public right-of-way of Highland Avenue and/or Bayview Heights or some combination thereof. Additional information regarding these three primary elements of the wastewater collection, treatment, and disposal facilities will be discussed in that order.

Additional information regarding the selected Wastewater Project includes a review of the present level of site planning and landscape design for the Resource Park; drainage management at the Resource Park; and, a progress report regarding the ongoing geotechnical investigation at the Resource Park. Also included in Section 10 is a review of potential environmental impacts and mitigation requirements. Other areas of investigation that are requested in the final Project Report by the State Board are not sufficiently developed at this stage to present, but will be presented in a latter draft. Cost impacts to users is an example of a topic whose discussion must be deferred until more of the financial planningwork has been done with the Wastewater Project and the cost estimates

STEG/STEP COLLECTION SYSTEM SERVICE AREA

The service area has increased over what was recommended in the Comprehensive Resource Management Plan to include Redfield Woods and Bayridge Estates. At full buildout, the collected population will be 76% of the total population living within the Urban Reserve Line of Los Osos.

STEG/STEP SERVICE POPULATION

Multiple counts of the number of individual homes, multi family residential units, mobile homes, motels, cafes and restaurants, schools, and commercial establishments were made within the Prohibition Area and the Urban Reserve Line. The units counted were categorized and the number of potential service connections for STEG/STEP collection was estimated. Finally, the counted units were converted to a common unit known as dwelling units equivalents (DUEs). These results were compared with the results of counts made by members of Los Osos CSD wastewater committee who have prepared numerous surveys over the past several years and as recently as in the last two months. Vacant properties were also counted with the aid of San Luis Obispo County Assessment Maps in order to estimate the full buildout population.. By definition, single family homes were counted as 1 DUE. Multifamily residences were counted as 0.75 DUE, and mobile homes as 0.5 DUE. Commercial and industrial establishments were estimated using tables of expected wastewater flow common in the wastewater industry. as common as 49 gpcd ?

A total of 3,951 existing DUEs were counted, and at full buildout 4,917 DUEs were estimated.

STEG/STEP RETICULATION

The geometry of the collection system layout is shown in Figure 1.3 and Figure 1.7. The layout was made in the field using uncommonly accurate maps provided by the Los Osos CSD Wastewater Committee. Supplemental elevation data were taken from County maps used also for the collection system plans by Metcalf & Eddy (1997).

TYPES OF COLLECTION SYSTEMS

Wastewater collection system layouts were made in two alternative types. Most of the area is proposed to be served with small diameter septic tank effluent gravity sewers, known as STEG sewers. This type of sewer uses a septic tank at each home, so only septic tank effluent is conveyed to the sewer main, relatively free of grit, grease, and other matter that may be troublesome to transport. The mains have comparatively small diameters, as small as three-inch diameter. The mains are more shallowly buried than conventional sewers, which is possible because they can be placed on flatter slopes than conventional sewers. Self-cleansing velocities are less critical than in conventional sewer practice due to the absence of solids in the effluent.

Where gravity flow is not attractive, pump stations are used similar to conventional sewerage practice. As an alternative to the use of mainline pump stations, some areas may be served by septic tank - effluent pump (STEP) pressure sewers. As with STEG, STEP systems also use shallowly buried, small diameter PVC pipelines.

STEP and STEG systems are recognized alternative sewer systems and are described in detail in the U.S. EPA Manual Alternative Wastewater Collection Systems, EPA/625/1-91/024. The service connections contemplated for the STEG/STEP Collection System are shown in Figure 5-1.

STEG/STEP DESIGN FLOWS

Flows adopted for this preliminary design assume a peak to average ratio of 4. That is, Qp = 4Qa where Qp is the peak flow, and Qa is the average daily flow, taken as 213 gpd/DUE per the Comprehensive Resource Management Plan. This results in peak design flows of 0.6 gpm per DUE. To this figure an allowance for unavoidable infiltration and inflow (I&I) is added. An I&I allowance of 1,500 gpd/acre has been adopted. A land area of 50 feet x 125 feet per DUE has been assumed, or 0.15 gpm per DUE. The sum of domestic wastewater plus the I&I allowance results in the adopted design flow of 0.75 gpm per DUE.

The equation Q = 0.75n produces flows that are too low when used for very low values of n (number of DUEs), but that is of little concern because the purpose is to determine the sizes of the mains and a minimum pipe size of 3-inch is used.

STEG/STEP MAIN SEWER SIZING

Mains have been sized with the customary assumption of flowing half full. A Hazen-Williams C factor of 120 was used in estimating headloss, which corresponds to a Manning's n of approximately 0.011. Pipe dimensions were taken as nominal. A minimum main size of three-inch diameter has been adopted for reasons of avoiding the marginal hydraulic capacity the use of smaller mains would provide. Also, they ventilate better than smaller pipelines, they are more rugged, and three inch is the smallest size readily available with the preferred rubber-ring joint. Also, there is little cost savings in using smaller pipe.

Table 10-1. Footages of sewer main with Redfield Woods and Bayridge Estates.

3"	4"	6"	8"	10"	12"	Sum
95,000	15,600	14,900	21,200	4,100	6,100	156,900

Table 10-2. Existing and Build-out DUE counts for the STEG/STEP Collection System including Redfield Woods, Morro Palisades, and Bayridge Estates.

	Existing			Build-out		
Category	Unit	Conn.	DUE	Unit	Conn.	DUE
Single Family Residential 1 DUE/home	2,612	2,612	2,612	3,573	3,573	3,573
Multi-family Residential 0.75 DUE/home	923	215	692	1,843	400	1,382
Mobile Home 0.5 DUE/home	490	5	245	490	5	245
Motel DUE=80 x BR ÷ 375	2	2	10	2	2	10
Cafes DUE=40 x seats ÷ 375	20	20	63	20	20	63
Schools DUE=20 x no. students & faculty ÷ 375	3	3	65	3	3	65
Commercial DUE=1 DUE/10,000 sq. ft.	110	110	260	137	137	369
Total	4,160	2,967	3,947	6,068	4,140	5,707

Unit: number counted
Connection: number of service connections to main
DUE: Dwelling Unit Equivalents

Table 10-3. STEG/STEP Effluent Characteristics.

Parameter	Units	Weighted Average[1]	Design Septic Tank Effluent[2]	Design Septic Tank Effluent+ Septage
Flow	gal/capita/day	49	65	65
BOD_5	mg/L	142	107	135
BOD_{ult}	mg/L	237	179	225
COD	mg/L	289	218	280
pH	–	6.9	6.9	6.8
DO	mg/L	0.3	0.4	0.2
Total Solids	mg/L	376	283	447
Total Suspended Solids	mg/L	54	41	103
Volatile Suspended Solids	mg/L	37	28	69.1
Total Dissolved Solids	mg/L	260	195	255
Total Sulfides	mg/L	2.0	1.5	3.5[4]
Total Nitrogen	mg/L	**38**	35.5	41.7
Ammonium-N	mg/L	**31**	28	28.6
Organic-N	mg/L	**8.25**	10.4	12.7
Nitrate-N	mg/L	**0.42**	0.4	0.4[3]
Phosphorus	mg/L	**5.9**	4.05	5.05
Alkalinity	mg/L as $CaCO_3$	225	176	180
Grease	mg/L	39.0	30	62.9

[1] Water Pollution Control Federation. (1986). Note: These composited septic tank effluent data come from Bend, Oregon; Glide, Oregon; Manila, California; and Madison, Wisconsin, all locations that have higher annual rainfall than does Los Osos. There were no weighted averages for total nitrogen, nitrogen species, and phosphorus; **average nitrogen and phosphorus values for Los Osos septic tank effluent were taken from Brown & Caldwell (1983).**

[2] The dilution is 49 gpd ÷ 65 gpd = 0.75 is the dilution factor.

[3] Nitrate is not likely to be found in septage.

[4] Meisner, (1979).

Table 10-4. The influence of septage on Los Osos wastewater incremental concentrations of major parameters.

Parameter	Design (mg/L)	Daily Input (mg)	Daily Increase (mg/L)	Yearly Concentration (mg/L)
Total Solids	40,000	9.1×10^8	240	164
Total Volatile Solids	25,000	5.7×10^8	150	102.6
Total Suspended Solids	15,000	3.4×10^8	90	61.5
Volatile Suspended Solids	10,000	2.26×10^8	60	41.0
Biochemical Oxygen Demand (BOD_5)	7,000	1.59×10^8	42	28.7
BOD_{ult}	11,200		67	46
Chemical Oxygen Demand	15,000	3.4×10^8	90	61.5
Total Kjeldahl Nitrogen	700	1.58×10^7	4.17	2.85
Ammonium-N	150	3.4×10^6	0.90	0.61
Total Phosphorus	250	1.58×10^8	1.5	1.0
Alkalinity (as $CaCO_3$)	1,000	2.26×10^7	6.0	4.1
Grease	8,000	1.81×10^8	48	32.8
pH	6.0	----	6.0	6.1
LAS	150	3.4×10^6	0.88	0.60
Fixed solids	15,000	3.4×10^8	88.5	60.5

Basis: Sewage flow: 1.0 million gallons per day
Septage flow: 6,000 gallons per day
Septage pumped 250 days per year.

(10) EPA Handbook Septage Treatment and Disposal, 1984.

SUMMARY OF RELEVANT DESIGN CRITERIA FOR THE AIWPS® FACILITY

Advanced Facultative Pond:	BOD decay constant for 8° C; 15 ft
Hydraulic Residence Time in AFP:	20 days
Supplementary Aeration:	28 lbs O_2/kWh/d; 70 HP (4 15-HP; 2 5-HP)
High Rate Pond:	5-8 day HRT at 1.5 to 2.0 ft of water depth; match algal cell concentration to influent BOD_{ult}.
Algae Settling Pond:	1 day HRT; 12 ft. deep; quarterly algal harvesting
DAF:	Influent TSS 100 mg/L; effluent TSS <10 mg/L
Maturation Pond:	12-15 day HRT; 12 ft. deep
Final Filter:	effluent less than 1 NTU
Final Disinfection:	effluent less than 2.2 MPN/100 mL
Broderson Disposal Site:	36 5-ft diameter with insert pipe recharge wells

Given the integration and multiple functions provided by the AIWPS® Facility and the Resource Park, the landscape plan for both the Resource Park and the wastewater treatment facilities will be discussed, followed by a discussion of the drainage management at the Resource Park, followed by a discussion of the geotechnical engineering evaluation of the Resource Park site that is ongoing.

LANDSCAPE PLAN FOR THE RESOURCE PARK AND AIWPS® FACILITY

The landscape plan for the Los Osos Wastewater Project includes all landscaped areas within the 29.5-acre AIWPS® Wastewater Treatment and Water Purification Facility, as well as the adjacent park lands and the storm drainage riparian corridor. The landscape plan has five primary goals:

1. Establish a visually striking landscape that unifies all uses within the 70 acre site, creating an integrated recreation and water resource facility for Los Osos/Baywood Park.

2. Utilize native or naturalized plant species and landscape patterns to the extent possible.

3. Provide extensive pedestrian access throughout the entire site, including the creek/drainage corridor, adjacent parklands, along streets, and within the treatment facility itself.

4. Create a naturalized riparian corridor ("Little Bear Creek") that accommodates storm water flows and provides wildlife and recreation functions, while establishing a visual edge along the AIWPS® Wastewater Treatment and Water Purification Facility.

5. Protect and enhance distant views from Los Osos Valley Road.

The Resource Park site includes a variety of land use and landscape areas which are listed in Figure 1.8 above and described more fully below. These areas include: (1) AIWPS® Wastewater Treatment and Water Purification Facility; (2) "Little Bear Creek" Drainage and Riparian Corridor; (3) Community Park and Open Space; (4) Multi-Use Fields and Emergency Water Storage Area, (5) Los Osos Valley Road; and, (6) Palisades Road and Skyline Drive Streetscapes.

PRELIMINARY LANDCAPE PLAN FOR THE AIWPS® WASTEWATER TREATMENT AND WATER PURIFICATION FACILITY

The AIWPS® Facility is comprised of a series of linear ponds arranged to step down the natural occurring slope of the Resource Park site, creating a visually interesting environment as well as maximizing the use of gravity in the natural wastewater treatment process. The approach taken in site planning is similar in concept to rice paddies located on steep slopes, where the human-made terrace forms of the paddies are shaped by the natural terrain. This arrangement will produce a distinctive landscape within Los Osos, reflecting the function of the pond treatment system and the adaptation of its design to the sloping site. Additionally the landscape treatments utilize natural materials and patterns found locally. Each of the ponds vary in depth and geometry depending upon the particular function in the overall sequential wastewater treatment and water purification process. The primary types of landscape areas within the treatment facility include service roads, levees, and berm slopes; the visitor center and operations buildings area; and, the septage receiving station.

The slopes surrounding each of the treatment ponds generally consist of three types of treatment. Areas between the water line, the hard surface that extends slightly above the elevation of the water surface, and the inside top of berm (i.e. the freeboard area) within each pond will be lined with a textured concrete where most accessable and visible. The textured concrete will create a visually pleasing, sculptured edge above the water line and will limit vegetative growth within the internal berm slopes of the ponds thereby reducing maintenance requirements. Between most ponds, a 14- foot wide, asphalt surfaced service roadway will provide operator access to the treatment ponds. Portions of pond slopes above the cobble edge and in areas without the service road will generally be planted in groundcovers and/or grasses, similar to the native coastal chaparral found in the Los Osos area.

Midway through the AIWPS® Facility, a wider grade separation occurs that includes a public multi-use trail connecting community parklands on the east and west sides of the Resource Park site and affording pedestrians sweeping views to Morro Bay. Limited tree planting will occur in this area in order to visually break up the treatment facility into smaller pieces. Elsewhere, tree planting will be limited in order to minimize the amount of leaves and debris that enter the ponds.

not like glossy.

Generally, all ponds will be fenced to limit public access and contact with the wastewater being treated in the ponds. Wherever possible, fencing will be located within planted areas with larger shrubs or vines utilized to minimize visual impacts. Fencing will be black, or possibly green, vinyl clad chain link. The Maturation Pond, which is the final stage of treatment, may be unfenced during normal operation. The Maturation Pond is located along the extension of Skyline Drive, providing a dramatic foreground to the visitor and operations center and views of the creek corridor and the network of pedestrian paths and jogging trails. not likely glossy.

Located off Palisades Drive, a new driveway and bridge over newly created "Little Bear Creek" will provide access to the visitor and operations area that includes a cluster of three small buildings: the visitor information and interpretive building, the operations control center and water quality laboratory building, and the maintenance shop and equipment storage building. The grounds around these buildings will be landscaped with native trees and shrubs, particularly around the small parking lot and the entry to the visitors center. The buildings are located to afford sweeping views of the entire AIWPS® Facility and surrounding park. Maintenance roads the surround the ponds are all accessible from this point on the site.

The septage receiving station, consisting of a truck drive-through and discharge area and underground vaults, is located at the southwest corner of the Resource Park site. This area will be fenced and screened from the adjacent park and open space lands as well as from nearby residences. Buffer planting will consist of evergreen trees and shrubs, as well as plantings of fragrant plants such as honeysuckle and jasmine. That ought to help odors!

DRAINAGE / RIPARIAN CORRIDOR AND INFILTRATION BASIN

Existing drainage through the site is collected and routed through a newly created corridor, referred to as "Little Bear Creek". The intent is to establish a naturalized drainage and riparian corridor that thoroughly cleanses initial stormwater runoff, as well as conveying the infrequently occurring, large volume storm flows. This new creek corridor is approximately 3,700 feet long, traversing the Resource Park site from south to north and providing a major new recreational amenity for the Los Osos community. The creek corridor is designed to accommodate normal and storm flows in a natural appearing channel. The watercourse is designed to reduce drainage velocities, and therefore erosion, and to incorporate vegetated slopes and a series of small spillways between shallow pools along the creek corridor. This pattern of pools and falls will provide an opportunity to establish native woodland tree plantings consisting of oak, bay, buckeye, sycamore and other species in upland areas and more riparian species such as willow and alder in the lower, wetter portions. Native grasses, groundcovers and riparian plants will be used throughout the corridor, as appropriate. The portion of the creek corridor between the AIWPS® Facility and Palisades Drive is designed as a botanical garden, including a fine-grained network of pedestrian paths and more intensive natural landscaping.

Pedestrian trails will parallel the entire creek corridor with opportunities for crossings at selected areas. The decorative bridge accessing the visitor center is sited to allow a pedestrian under-crossing along the creek.

The creek crosses the extension of Skyline Drive, with water conveyed through large box culverts. These culverts are sized to accommodate stormwater flows as well as providing an undercrossing for small wildlife. North of Skyline Drive, a stormwater retention area is located to provide cleansing of the "first-flush" storm flows, and an evergreen windbreak will be planted along the southern edge of the Morro Shores Mobile Home Park. The main creek channel is separate from this linear basin which is designed to accommodate marsh grasses and other riparian vegetation. The creek corridor, including continuous pedestrian paths and access continues northward, providing a buffer between the Mobile Home Park and the multi-use playing fields. The creek will be planted with native riparian and upland trees.

COMMUNITY PARK AND OPEN SPACE

Development of the Resource Park site will create substantial community park and open space area that provides for active and passive recreation needs of the community. The park and open space lands will surround and bisect the treatment and water purification ponds and provide a linear park along Los Osos Valley Road and Palisades Avenue linking to the existing community park. The park lands include the Los Osos Valley Road frontage, linear park/buffer along the west side of the site, the substantial 'upper meadow' in the southeast corner of the site, and the entire drainage/riparian corridor. Primary recreation facilities consist of the extensive path system, paved in a crushed gravel/decomposed granite, and large lawn areas for picnics and other non-organized activities. At strategic areas, overlooks are located to provide views of the AIWPS® Facility and long views to Morro Bay. Benches will be provided along pathways throughout the Resource Park.

North of the Skyline Drive, new parklands providing space for multi-use playfields will be developed. These sites, comprising approximately nine acres in area, will provide much-needed active recreation facilities for the community of Los Osos. The field areas are designed to accommodate emergency bypass disinfected secondary effluent from the AIWPS® Facility should the tertiary treatment facilities go offline for more than 14 days. During such rare occasions when disinfected secondary effluent bypasses the tertiary treatment facilities, the sculpted playing fields basins would be temporarily fenced to restrict public access, but the first water to enter these playing field basins will be tertiary disinfected final effluent that will be stored in the Maturation Pond until an emergency bypass situation requires the release of final tertiary effluent from the Maturation Pond to allow for the storage of the disinfected secondary effluent. Assuming that the tertiary treatment facilities would be back online within 14 days, the playing fields/emergency bypass basins would not receive any water other than the final effluent which could percolate through the soil as would the storm runoff.

Landscape treatments include perimeter tree planting and irrigated turf for the playing fields. Slopes along the eastern edge are designed to accommodate a small amphitheater and to provide informal seating for viewing of sports activities. Parking for the fields would be accommodated along the street extension of Palisades Drive.

Planting of the park lands primarily include clusters of native oak trees and planting of the riparian corridor described above. Plantings of Monterey Cypress would occur along the west edge of the Resource Park site, the south side of the mobile home park, clusters along Los Osos Valley Road, and at roadway intersections. The Upper Meadow, the Los Osos Valley Road frontage, and the multi-use playing fields will be planted in lawn for recreational use; however, the majority of the remaining park lands will be planted in native and naturalized grasses and shrubs to recall or re-establish the native chaparral.

LOS OSOS VALLEY ROAD STREETSCAPE

The Los Osos Valley Road frontage will be planted as an visual extension of the linear park described above. Clusters of oaks will allow distant views across the Resource Park site toward the Bay. Walking paths from the Resource Park will connect to the proposed bicycle/pedestrian paths at several points.

PALISADES AVENUE AND SKYLINE DRIVE STREETSCAPE

Two different streetscape treatments occur along existing and proposed extensions of Palisades Avenue and Skyline Drive. From Los Osos Valley Road to the Skyline Drive extension, Palisades Avenue will be planted with regular spaced street trees near the curb. Sidewalks will be installed along both sides of the roadway where none currently exist. North of the Skyline Drive extension, regular spaced street trees will be located along the eastern edge of the roadway, while the west side will be planted with clusters of evergreen trees to frame views to the new field areas. Paths will be located on the west side only.

In a similar manner, the Skyline Drive extension will include sidewalks and plantings of regular spaced street trees east of Palisades Avenue. West of this intersection, the landscape will consist of clusters of native tree and shrub planting to provide views to the Maturation Pond and to reinforce the riparian environment of the retention basin and creek corridor.

FUTURE DEVELOPMENT AREA

A small area designated for development is located along Palisades Avenue at the intersection of the future extension of Skyline Drive. Additionally, a small site for a future government center development may be located near the existing library, occupying a portion of the area now designated as the Upper Meadow.

STORMWATER MANAGEMENT PLAN FOR THE RESOURCE PARK SITE

The stormwater management plan for the Los Osos Wastewater Facilities Project has three goals. They are: 1) to convey large stormwater flows safely from the upland areas above the Resource Park Project Site to Morro Bay; 2) to treat the stormwater using best management practices (BMPs) so that pollutants contained in the stormwater runoff will not adversely impact Morro Bay and the estuary; and, 3) to recharge a portion of this stormwater to the groundwater aquifer.

REVIEW OF RESOURCE PARK SITE CHARACTERISTICS

The Resource Park site is located in the mid to lower portion of a north facing slope at the southern end of Morro Bay. The area is generally characterized by wind blown sand deposits of the Holocene age. These deposits are quite permeable, and the site is underlain by a complex shallow aquifer or group of shallow aquifers and a deep groundwater aquifer. Up gradient from the Resource Park site and Los Osos Valley Road is a developed residential area (Redfield Woods) that extends about 1,500 ft. upslope to an elevation of 150 feet above sea level. Above the developed residential neighborhood of Redfield Woods are two relatively large undeveloped properties that currently provide recreational open space and a greenbelt to the community of Los Osos. These two properties known as Broderson and Morro Palisades also provide prime habitat for several endangered plant and animal species.

The developed portion of the watershed that contributes storm runoff to the Resource Park site is the area of greatest concern for urban/suburban runoff and non-point source pollution. This runoff will be managed through the Resource Park site, and the first flush which carries the heaviest non point source pollutant load, will be retained and cleansed through soil filtration protecting Morro Bay National Estuary. Below the Resource Park site is the protected Bay-front area known as Sweet Springs and its surrounding marshlands. This area is a fresh water marsh ecosystem on the western fringe of Morro Bay near the Los Osos fault.

HYDROLOGY

A previous drainage study by EDA (1997) determined the size and character of the contributing sub-watersheds that deliver stormwater runoff to the upper boundary of the Resource Park site. Table 10-5 shows the sub-watersheds defined in the study, the area for each watershed, and the 10-, 25-, 50- and 100-year return period rainfall runoff peak flows.

Table 10-5. Areas contributing runoff to the Resource Park site.

Peak Flow (cfs)

Area	Description	Area (acres)	10 year	25 year	50 year	100 year
16A	Below the Project Site	35	25	32	38	48
16B	Project Site	65	22	28	41	56
16C	South area above Highland to Broderson	106	54	68	88	115
16D	South area above Highland down	201	24	30	61	95
16E-F	South area Bay View to Palisades					
	South area Bay Oaks to Palisades	164	20	25	51	79
Total to Project Site – Sub areas B, C, D, E, F			**120**	**151**	**241**	**345**

Data from the EDA, Inc. Los Osos/Baywood Park Drainage Report.

Runoff from the undeveloped portions of the project site contributing sub-watersheds is moderate due to the permeability of the sand dominated geology. The peak flows shown in Table 10-5 are derived from intensity-duration-frequency curves developed for this area of the County. The corresponding 24 hour rainfall amounts for the 10, 25, 50, and 100 year storms are 4", 4½", 5", and 5¾" respectively. Each of the sub-watersheds B through F have time of concentrations of about one hour. Sub-watershed A which is below the project site has a time of concentration of about 20 minutes. As can be seen from Table 10-5, 100 year peak storm flow through the site is 345 cfs. For a wastewater facility the 100 year storm is the appropriate and conservative design assumption and is used for this stormwater management plan.

BEST MANAGEMENT PRACTICES

The conveyance of stormwater through the site is intended to not only provide for safe passage of these flows but provide treatment of the pollutant carrying portion of the stormwater runoff. To meet both of these goals a combination of design elements are used. The pollutant reduction aspects of the design center on the first flush portion of rainfall runoff. The design rainfall selected for water quality control is the smaller, frequent event which will normally occur several times per year. Generally the major percentage of pollutants are carried by the first increment of runoff from a storm event. This first increment washes off or "flushes" the concentrated pollutants which have accumulated on streets, paths, driveways and parking areas since the last rainfall. This first flush, generally the first ¼ to ½ inch of runoff can carry over 90% of the total suspended and dissolved pollutants in stormwater. Treating this first increment of runoff and safely conveying the much larger infrequent event peak flows is the concept behind the drainage plan.

CONVEYANCE AND TREATMENT CHANNEL/RIPARIAN CORRIDOR

Due to limited project site area a portion of the treatment effectiveness will rely on the conveyance channel as well as off-channel detention The channel geometry is flat bottomed, (in cross section) vegetated and, at the steeper sections of the site, contain intermittent log or boulder falls of a few inches to a foot or more, spaced at varying intervals to provide for slight sloped pool and run sections in between the falls. These pool/run areas provide a lower velocity, quiescent area for in-channel sedimentation, filtering and infiltration to occur. In addition, the channel and abutting areas will be vegetated and landscaped to provide a riparian corridor for wildlife habitat.

The channel will be designed for three flow regimes, the low flow first flush, which will receive in channel treatment including sediment removal, filtering and biological nutrient uptake, the 10 year return period storm for which the channel will be designed to remain stable and non-eroding, and the 100 year storm, which will be safely conveyed through the site allowing for adequate freeboard, but potentially some erosion may occur. This approach is taken to utilize the site in the most effective manor and providing for safe conveyance of extreme storm events. The flat bottom of the channel will be about twenty five feet wide with side slopes at three to one and slighter.

The channel originates at the upslope portion of the site at Los Osos Valley Road, and runs northward along the western side of the AIWPS® Facility and to areas which widen into pool/habitat reaches then terminates into a culvert at the northern boundary of the site. The reaches which contain increased slope will be protected with riprap, boulders and log falls. The lesser slope areas will be vegetated with a variety of native grasses, shrubbery and riparian trees to stabilize the channel bottom and side slopes.

DETENTION BASIN

Another feature of the site stormwater management plan is the use of a detention/infiltration basin to provide first flush sedimentation and biological uptake of nutrients. This basin is to be located directly downslope of the wastewater treatment plant and will provide another layer of stormwater treatment for the site. The basin is sized to retain and treat the first ½ inch of runoff from the urbanized area directly upslope from the project site, or about 3 to 4 acre-feet of runoff. As described above, since the developed area is directly adjacent and upslope of the site, and as the impervious surfaces will generate the earliest increment of runoff, this runoff will enter the project site first. The detention basin will be designed to receive the first flush runoff and allow for subsequent runoff to flow past the basin in the adjacent vegetated channel. Flow into the basin and subsequent bypassing will be accomplished using a diversion structure and weir. The runoff that fills the basin will be detained, will receive treatment through settling and biological nutrient removal and subsequently will infiltrate into the basin subsurface.

RUNOFF TREATMENT EFFECTIVENESS

Treatment of runoff using the conveyance channel, pool areas and detention basin is intended to reduce sediment, which carry the greatest percentage of pollutants, and reduction in nutrients such as nitrogen, phosphorus and trace metals as well as reducing oxygen demand. A basin of the type planned for the project site has been shown to reduce suspended solids by over 80%, achieve nitrogen, phosphorus reductions of 60% to 80% and trace metals by over 80%. In addition, filter strips or vegetated swales and channels have been shown to reduce these constituents by 40% to 80% (Schueler 1987). The channel, as designed, will have the added feature of providing infiltration and pool areas that allow even greater reduction of pollutants, while providing a wildlife riparian corridor.

GEOTECHNICAL ENGINEERING EVALUATION OF THE RESOURCE PARK SITE

This report provides preliminary geotechnical information based on one hand auger, 5 cone penetration test (CPT) soundings, a groundwater level reading in an existing monitoring well located at the east terminus of Skyline Avenue, and previous subsurface data available for the site vicinity. The approximate locations of the hand auger boring, CPT soundings, and monitoring well are shown on Figure 1.

FIELD EXPLORATION

Field engineers of CFS drilled the hand auger boring near the center of the treatment plant site on December 9, 1999. The hand auger was advanced to a depth of approximately 25 feet below the existing ground surface and encountered groundwater at a depth of approximately 24 feet.

The cone penetration testing (CPT) subcontractor for this project was Gregg In Situ, Inc of Martinez, California. A field engineer from CFS observed the CPT soundings. Five CPT soundings were advanced along the perimeter of the site on December 11, 1999. The soundings were advanced to depths of approximately 41 to 69 feet below the existing using an electric piezocone penetrometer that is advanced using a hydraulic ram mounted on a 20-ton truck. During penetration, the cone tip resistance (q_c), sleeve friction (f_s), and pore water pressure (u) where recorded using an on-board computer to provide a continuous profile of the conditions encountered. At various depths within each CPT sounding the penetration of the cone was paused to allow for the pore water pressure to stabilize and estimate groundwater levels.

Two CPT soundings available from the previous field exploration program performed for the County project are referenced in this letter. One of the previous CPT soundings was performed at the east end of Skyline Drive near west boundary of the site. Another CPT was performed on Ramona Avenue approximately 400 feet east of Broderson Avenue, near the northern end of the site.

SUBSURFACE CONDITIONS

The subsurface conditions encountered generally consist of a relatively thin thickness of artificial fill materials (Af) that overly dune sand deposits (Qs) and Paso Robles Formation (QTp). The locations of the explorations are shown on Figure 10-1. A summary of the soil conditions encountered in the explorations is presented below.

Artificial fill materials (Af). Artificial fill materials were encountered in each of the CPT explorations. The CPT explorations were advanced to various depths along the perimeter of the site within the pavement areas of Palisades Avenue, on the shoulder of Los Osos Valley Road, and or Broderson Avenue. The fill materials appear to be associated with the previous grading and paving of the Palisades Avenue, Los Osos Valley Road and Broderson Avenue and do not appear to extend outside of the roadway area. The artificial fill materials generally consisted a relatively thin (less that 2-feet) of asphalt concrete pavements and compacted fill material that appear to be derived from the dune sand deposits. Where encountered, the artificial fill materials are underlain by dune sand deposits.

Dune sand deposits (Qs). Dune sand deposits were encountered in each of the explorations and appear to cover the majority of the proposed project area. The dune sand deposits were encountered below the fill materials or at the ground surface to approximately 5 to 27 feet below the existing ground surface where CPT explorations were performed in the roadways along the site perimeter. The dune sand appears to be mounded over the Paso Robles Formation at the site. The thickness of the dune sand is therefore expected to vary with the topographic relief. A greater thickness of dune sand is expected to underlie the higher portions of the site, and a lesser thickness of dune sand is expected to underlie the lower portions of the site. The dune sand deposits encountered in the explorations generally consist of loose to medium dense silty sand (SP) and sand (SP). Paso Robles Formation underlies the dune sand deposits.

Paso Robles Formation (QTp). Paso Robles Formations was encountered in each of the explorations below the dune sand deposits. The Paso Robles Formations was encountered below the dune sand deposits to the maximum depth explored, approximately 69 feet below the existing ground surface. Practical refusal was encountered in CPT 2 and CPT 5 at depths of approximately 41 and 69 feet, respectively. The Paso Robles Formation encountered in the explorations generally consists of interlayered dense to very dense sand with clay (SP-SC), silty sand (SM), silty clayey sand (SC-SM). Preliminary CPT soundings also indicate that the Paso Robles Formation soils contain layers of cemented sand and soils encountered along Palisades contained interbedded clay layers.

GROUNDWATER CONDITIONS

Groundwater was encountered at a depth of approximately 24 feet in the hand auger boring drilled near the center of the main treatment facility. Groundwater was interpreted from pore water readings in CPT soundings 1 through 4, performed along the perimeter of the southern portions of the site. The depth to groundwater interpreted from CPT1 through CPT4 is approximately 14 to 34.5 feet below the ground surface. We interpreted that groundwater was not encountered in CPT 5 during penetration. However, after the sounding was completed we did measure a pore water pressures indicating groundwater was encountered near the final depth.

The new site layout extends into the northern "pan-handle" portion of the property. Groundwater was previously encountered at a depth of approximately 14 feet in CPT144 performed in January 1997. Ramona Avenue is furthered to the north by Sweet Springs and Morro Bay.

Soils encountered along Palisades are interbedded with clay layers, and the shallow groundwater conditions appear complex. We expect that groundwater is perching on some of these layers, and therefore "first groundwater" depths may vary, and may be confined at some locations. A summary of the groundwater depths and elevations encountered is presented below:

	79.5 ft.	14 ft.	65.5 ft.	50 ft.
CPT2	96.5 ft.	22 ft.	74.5 ft.	41 ft.
CPT3 LOVR near	101 ft.	25 ft.	76 ft.	50 ft.
CPT4 LOVR/Ravina	95 ft.	34.5 ft.	60.5 ft.	60.5 ft.
CPT5	113 ft.	67 ft.	46 ft.	69 ft.
H-1 (Hand auger)	64.5 ft.	24 ft.	40.5 ft.	25 ft.
Skyline MW	50 ft.	24 ft.	26 ft.	33 ft.
CPT144 Ramona	27 ft.	14 ft.	13 ft.	25 ft.

Groundwater conditions will vary seasonally, due to storm runoff, groundwater pumping, as well as other factors.

SLOPE DESIGN

Limited laboratory testing was performed on a soil sample retrieved from the hand auger borings. Direct shear test results on a remolded sample had a friction angle of approximately 30 degrees and no cohesion. The results suggest that unless near surface soils are confined that the soils are potentially unstable at slope inclinations steeper that approximately 2.5h:1v. The estimated slope inclination is preliminary, and will be reevaluated using slope stability analyses once site-specific subsurface data has been obtained.

On the basis of the soils encountered during our field explorations, we expect that interior lined slopes can be preliminarily designed at 2.5h:1v. We understand that all of the interior slopes, except for the northern most maturation pond, are designed using a 2.5h:1v slope inclination. The slopes for the maturation are designed at 2h:1v. Slope steeper than 2.5h:1v will likely need to be reinforced using geosynthetics or with slope paving.

The near surface soils at the site are fine sand that is highly erodable. The exterior slopes should be designed at 3h:1v or flatter for conventionally graded slopes with minimal landscaping. If the slopes are vegetated, and erosion control matting is used, a slope inclination of 2.5h:1v can likely be used for exterior slope design. The use of permanent erosion control matting and/or geosynthetic slope reinforcements can likely be used if exterior slope inclinations of 2h:1v are needed.

Drainage should not be allowed to run over slopes. Lined ditches or other erosion control devices should be provided at drainage outlets and in areas of concentrated runoff. These soils are likely to erode where surface water velocities are only 1 to 2 feet per second, and may be less.

GEOTECHNICAL CONSIDERATIONS

The main geotechnical considerations that we expect will need to be addressed for design are:

Dune sand deposits are present over most of the site. The dune sand deposits are relatively loose and potentially compressible near the ground surface. We expect that the portions of the existing soils will need to be removed from building, roadway and areas to receive fill, and be replaced with compacted fill material. For preliminary design, we expect that the soils will likely need to be removed to depths of approximately 3 to 6 feet below the existing ground surface. Deeper depths of excavation may be needed in areas of the site that are heavily eroded, such as the gullies extending from the north shoulder of Los Osos Valley Road.

A fault is interpreted to trend northwest along the east boundary of the site. The existence and location of the fault is inferred by offsets in measured groundwater levels based on previous studies by the United States Geological Survey, and subsequent groundwater data compiled by Mr. Don Asquith, Engineering Geologist. The fault is referred to as Trace B of the Los Osos fault. Portions of the Los Osos fault are zoned active. We plan to evaluate the location, presence and activity of the fault based on additional CPT work and trenching once access to the site can be provided. If present, the ponds will likely need to be setback at least 50 feet from any trace of the fault.

Groundwater was encountered at elevations ranging from a low of el. 13 feet MSL on Ramona Avenue to a high of el. 76 feet MSL near the intersection of Los Osos Valley Road and Palisade Drive. We expect that groundwater could be encountered in the deeper ponds (the Maturation and Emergency Bypass reservoirs) depending on the groundwater level at that location. Dewatering could be needed to allow for excavation of the ponds, and the installation of the lining.

Groundwater on the east side of the inferred Los Osos fault is estimated to be within the 5 feet of the ground surface. Groundwater is therefore likely shallow along the eastern property line if Trace B of the Los Osos fault is present in this area; however, we do not expect that the ponds will be constructed across the fault. The groundwater is deeper west of the fault. The groundwater data referenced in this report are all west of the estimated location of the fault.

The treatment plant buildings can likely be supported on shallow foundations bearing in compacted fill.

SUMMARY OF COSTS IMPACTS

A summary of cost impacts on wastewater system users will be prepared in consultation with the Assessment District Engineer, Bond Counsel, and the Financial Consultant. The estimated project costs that will be used are given in Section 5. This topic has not been sufficiently explored in order to present an evaluation of the cost impacts to wastewater users at the present time.

PROPOSED INTERAGENCY AGREEMENTS

SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION.

The potential environmental impacts of the project are outlined below. Impacts are similar in nature to those described in several prior Environmental Impact Reports (EIR) prepared for the County of San Luis Obispo during its tenure as the project proponent. Another EIR will be prepared for the LOCSD wastewater project, and it will incorporate and update information from the previous documentation.

BACKGROUND ON ENVIRONMENTAL ANALYSIS

The County, working with representatives of County Service Area No. 9 which included most of the community of Los Osos, devised a plan for a wastewater treatment system based on conventional collection, treatment and disposal technologies. A Final Environmental Impact Report (FEIR) was prepared for this project in 1987. The FEIR addressed the following issues:

Geologic and seismic hazards	Noise
Groundwater hydrology	Air quality
Flooding and drainage	Agricultural resources
Biological resources	Growth inducement
Cultural resources	Alternatives
Visual resources	Economic and fiscal considerations
Traffic and circulation	

An addendum to the Final EIR was prepared in 1987 to address new information that became available regarding isotopes of nitrogen and their impact on the groundwater contamination problem. A second addendum prepared in 1989 addressed additional information regarding agricultural impacts associated with the proposed treatment plant site as well as more specific data regarding native plant life.

A supplemental EIR was also prepared in 1989 to provide an updated analysis of the following issues:

Geologic hazards	Sludge disposal
Groundwater hydrology	Growth inducement
Agricultural resources	Alternatives

A second supplemental EIR was prepared in 1997 to accomplish the following:

- Update the information contained in the 1987 FEIR to respond to any changes in the environmental setting which may have occurred since the original FEIR was certified, and since completion of the two addenda and the first supplement.

- Evaluate changes and potential changes in the project description relating to the service area boundaries; project phasing; alternative treatment plant site locations; alternative treatment processes; and modifications to the collection system.

- Status and Survey of the Banded Dune Snail (*Helminthoglypta walkeriana*). Prepared by Barry Roth (1985) for the U.S. Fish and Wildlife Service. Sacramento, California.

Additional work completed since the supplemental EIR includes:

- Informal discussions between U.S. Fish and Wildlife, Crawford Multari Clark & Mohr (CMCM) staff, and CMCM subconsultants.

ENVIRONMENTAL ANALYSIS AND MITIGATION

The LOCSD has concluded that a Draft and Final EIR are necessary to assess the potential environmental impacts of the project. The following issues have been identified for inclusion in the Draft EIR, which will be in addition to the work previously undertaken that will be incorporated by reference:

Biological Impacts. The land within and surrounding the community of Los Osos supports a wide range of sensitive plant and animal species that have been afforded special protective status by either the federal or State governments (or both). Two federally endangered species, the Morro Shoulderband snail and the Morro Bay kangaroo rat, may occur, or are known to occur, on lands proposed for the treatment facility and/or discharge sites. Construction of the treatment facility as proposed will result in the complete removal of potential native habitat on approximately 70 acres of the Resource Park. Disturbance of the proposed disposal sites will be more limited in area, but will nonetheless result in the disturbance and/or removal of potential habitat for sensitive plant and animal species. The DEIR will provide a complete analysis of potential biological impacts associated with these project components.

> Secondary impacts to biological resources will occur from the development of vacant lots containing limited habitat for sensitive plant and animal species. The DEIR will also assess these potential secondary impacts.

> Considerable additional analysis was performed in Los Osos subsequent to the release of the 1997 FEIR, mostly in preparation for the Coastal Commission

hearings. Extensive mapping and survey work was undertaken, although much of this on land not proposed for the current project. Nevertheless, there were many meetings with USFWS directed towards the finalization of a mitigation strategy for the Morro shoulderband snail.

Mitigation for impacts to endangered species will likely include the acquisition and protection of land containing appropriate habitat for the species of concern. Negotiations are underway with the USFWS for an appropriate ratio of replacement land. It is anticipated that approximately 100 acres of habitat will need to be accounted for with the project and secondary impacts.

Cultural Resources. Los Osos is known to be rich in archeological resources. Previous environmental documents contain extensive information regarding the extent and nature of known archeological sites within the community, many of which have been previously mapped. Construction of the treatment and disposal facilities and installation of the effluent collection system may adversely impact previously discovered and undiscovered archeological resources. The DEIR will contain a thorough analysis of potential impacts to these cultural resources, and will include Phase II testing as necessary.

Mitigation for cultural resources will involve identification, and where feasible, avoidance of resources. It is anticipated that the project approach to collection will have far fewer impacts to cultural resources because extensive deep trenching will not be required.

Hydrogeology and Water Resources. The purpose of the proposed collection and treatment system is to alleviate previously discovered groundwater pollution associated with nitrate levels in excess of State standards, and to help establish a sustainable supply of drinking water for the community. The proposed wastewater facilities will involve STEP/STEG collection facilities an AIWPS® Facility, as well as effluent disposal and/or reclaimed water reuse facilities intended to replenish and sustain the groundwater basin. The potential impacts of the wastewater collection, treatment and disposal facilities (beneficial and adverse impacts) on the groundwater quality and quantity will be throughly assessed by the DEIR. Particular emphasis will be given to the analysis of alternative disposal sites and disposal methods. Mitigation for impacts to water resources will be incorporated into the design and operation of the facility.

Geology. Potential geologic impacts include:

- The installation of wastewater collection, treatment and disposal facilities will result in the disturbance of soils and increase temporarily the potential for soil erosion and runoff;
- The proposed AIWPS® Facility site is located near the inferred trace of the Los Osos fault;
- Soils on the proposed AIWPS® Facility site consist of alluvial sands associated with the dune complex of the Los Osos area which may be subject to liquefaction.

The DEIR will contain a thorough analysis of potential impacts associated with soils and erosion, liquefaction, slope stability, and seismic disturbance.

Mitigation will be necessary at the treatment plant site and collection areas, especially during construction, to prevent erosion and maintain site stability.

Air Quality. Potential air quality impacts associated with the project include:

- Odors associated with the AIWPS® Facility;
- Construction-related emissions during the construction of the wastewater collection, treatment, and disposal/reuse facilities; and
- Secondary impacts associated with increased motor vehicle emissions resulting from development within the community once the discharge moratorium is removed.

The DEIR will assess the project's direct and indirect impacts on air quality and its consistency with the Air Quality Management Plan.

Mitigation measures will focus on reduction of PM_{10} and NOX emissions during construction. Odor control will be a function of the design of the facility.

Land Use and Consistency With Adopted Land Use Plans. The proposed 65-acre Resource Park in which the AIWPS® Facilities located on land bordered by low-density residential development to the north, south and east. At present, the site is designated for a multi-use business park in the County's Estero Area Plan, the portion of San Luis Obispo County's General Plan/Local Coastal Program which governs Los Osos. The

DEIR will thoroughly assess the project's consistency with adopted land use plans and policies.

Noise. Construction of the wastewater collection, treatment and disposal facilities will involve the use of heavy machinery which will generate temporary noise impacts. In particular, installation of the collection system will involve drilling or excavation throughout the collection area which will generate construction related noise impacts. The DEIR will evaluate potential noise impacts associated with these activities and recommend standard noise control mitigation measures.

Traffic. Traffic impacts to area streets and intersections could occur as a result of construction activities. Mitigation will include the development of a traffic safety plan for the project.

CONCLUSION

Environmental impacts from the development and operation of the project are reasonably well understood at this time due to the extensive environmental analysis performed for the County projects. The essential effort will be the assessment of biological impacts, and impacts specifically associated with the AIWPS® facility.

UNALLOCATED POTABLE WATER

None.

PREVIOUSLY-FUNDED FACILITIES

None.

CIVIL RIGHTS ACT COMPLIANCE

The Los Osos CSD will comply with the Civil Rights Act.

OPERATION & MAINTENANCE REQUIREMENTS

Operation and maintenance requirements will be included in the Facilities Plan.

CONSISTENCY WITH WATER QUALITY MANAGEMENT PLAN

Section 1 presents a discussion of the control of nitrogen and the consistency of the proposed Wastewater Project with the Regional Water Quality Control Board's Basin Plan.

PUBLIC PARTICIPATION

Section 9 presents a brief discussion of public participation. Certainly there will be more public participation over the next six months that will be reported prior to the Project Report being submitted to the State Water Resources Control Board.

DISCHARGE REQUIREMENTS

draft

Order Number 97-8 *Waste Discharge Requirements for San Luis Obispo County Services Area 9, Baywood Park/Los Osos, San Luis Obispo County* is attached.

ATTACHMENT 2

ID#3 401078001

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION
81 Higuera Street, Suite 200
San Luis Obispo, California 93401-5427

Draft **ORDER NO. 97-8**

WASTE DISCHARGE REQUIREMENTS
FOR
SAN LUIS OBISPO COUNTY SERVICES AREA 9,
BAYWOOD PARK/LOS OSOS
SAN LUIS OBISPO COUNTY

The California Regional Water Quality Control Board, Central Coast Region (hereafter Board), finds that:

1. San Luis Obispo County (hereafter Discharger) submitted a report of waste discharge (application) on October 22, 1996, for authorization to discharge treated municipal wastewater from proposed County Services Area (CSA) 9 Wastewater Treatment Facilities serving the communities of Cuesta-by-the-Sea, Baywood Park and Los Osos, in San Luis Obispo County.

2. The Discharger's Wastewater Treatment Plant will be located on property owned by the Discharger in San Luis Obispo County at the easterly end of Pismo Avenue, as shown on Attachment A, included as part of this Order.

3. The proposed treatment system consists of grit removal, secondary treatment (an activated sludge process) and secondary sedimentation. Solids will be aerobically digested, dewatered and disposed of at an approved biosolids disposal site. The treatment plant's average dry weather flow (ADWF) design capacity is 1.32 million gallons per day (MGD). A diagram of the treatment facility processes is shown on Attachment B, included as part of this Order.

4. Treated municipal wastewater will be discharged to 2.1 acres of infiltration basins at a separate location, shown on Attachment A. The Discharger proposes to incorporate recycling for landscape irrigation at a future date. However, details of water recycling projects are not yet available and provisions for recycling are not included in this Order. Details of the disposal system are depicted on Attachment C of this Order.

5. The disposal area is located on moderately sloping terrain, overlying approximately 150 feet of soil separation to ground water in the Los Osos Valley Ground Water Basin.

6. Existing ground water quality in the uppermost aquifer in the vicinity of the discharge includes:

Total Dissolved Solids	400 mg/l
Sodium	66 mg/l
Chloride	58 mg/l
Nitrate Nitrogen (as N)	23 mg/l

7. The Water Quality Control Plan, Central Coast Basin (Basin Plan), was adopted by the Board on and approved on September 8, 1994. The Basin Plan incorporates statewide plans and policies by reference and contains a strategy for protecting beneficial uses of surface and ground waters in the vicinity of the discharge.

8. Existing and anticipated beneficial uses of ground water in the vicinity of the discharge include:

   a. Municipal and domestic water supply;
   b. Agricultural supply; and
   c. Industrial supply

9. Federal Regulations for stormwater discharges were promulgated by the U.S. Environmental Protection Agency on November 19, 1990. The regulations [40 Code of Federal Regulations (CFR) Parts 122, 123, and 124] require specific categories of industrial activities including Publicly Owned Treatment Works (POTWs) which discharge stormwater to obtain a NPDES permit and to implement Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to control pollutants in industrial stormwater discharges.

10. Stormwater flows from the wastewater treatment facility process areas are directed to the treatment processes and discharged with treated wastewater. These stormwater flows constitute all industrial stormwater at this facility and consequently this Order regulates all industrial stormwater discharge at this facility along with wastewater discharge.

11. San Luis Obispo County certified a Final Environmental Impact Report (EIR) on December 8, 1987, with Supplemental EIRs prepared in September 1989 and (current draft November 1996) in accordance with the California Environmental Quality Act (Public Resources Code, Section 21000, et seq. and the California Code of Regulations.

    Pursuant to CEQA guidelines Section 15096, the Regional Board, as a responsible agency, has a more limited role than the lead agency. The Regional Board is responsible for mitigating or avoiding only the direct or indirect environmental effects of those parts of the project which it approves. The EIR does not identify any significant unavoidable environmental impact resulting from proposed wastewater treatment or discharge. Impacts relating to construction erosion, odors, biosolids disposal and wastewater discharge shall be mitigated by the proposed Order. Potentially significant impacts which fall within the purview of the Regional Board are as follows.

    Potential impacts to surface water quality from construction related erosion are identified. Mitigation measures are proposed including compliance with the statewide stormwater permit for construction activities. Another potential source of water quality impacts is from construction dewatering. Such discharges will also be regulated by the Board through separate order.

    In addition, there is potential for significant impacts to surface waters from an accidental spill of untreated wastewater from the collection system or treatment plant.

    Potential impacts to air quality form periodic odors and air emissions from the collection, treatment, or disposal facilities are considered unavoidable. The EIR does not identify negative impacts to groundwater quantity or quality which cannot be mitigated to insignificance. Mitigation measures to prevent nuisance and assure protection of beneficial uses of surface and ground waters will be implemented through this Order.

    Pursuant to CEQA guidelines Section 15096, the Regional Board, as a responsible agency, has a more limited role than the lead agency. The Regional Board is responsible for mitigating or avoiding only the direct or indirect environmental effects of those parts of the project which it approves. The EIR does not identify any significant environmental impact resulting from proposed wastewater treatment or discharge. Insignificant impacts relating to odors, biosolids disposal and wastewater discharge shall be mitigated by the proposed Order.

12. A permit and the privilege to discharge waste into waters of the State are conditional upon the discharge complying with provisions of Division 7 of the California Water Code and of the Clean Water Act (as amended or as supplemented by implementing guidelines and regulations) and with any more stringent effluent limitations necessary to implement water quality control plans, to protect beneficial uses and to prevent nuisance. Compliance with this Order should assure conditions are met and mitigate any potential changes in water quality due to the discharge.

13. On **December 20, 1996**, the Board notified the Discharger and interested agencies and persons of its intent to consider adoption of waste discharge requirements for the discharge and has provided them with a copy of the proposed Order and an opportunity to submit written comments and scheduled a public hearing.

14. In public hearings on February 7, 1997 and April 4, 1997, the Board heard and considered all comments pertaining to the discharge and found this Order consistent with the above findings.

IT IS HEREBY ORDERED, pursuant to authority in Section 13377 of the California Water Code, that San Luis Obispo County, its agents, successors, and assigns, may discharge waste from the County Services Area 9 Wastewater Treatment Facility providing compliance is maintained with the following:

(Note: General permit conditions, definitions and the method of determining compliance are contained in the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated January 1984, referenced in paragraph D.2. of this Order.)

Throughout these requirements footnotes are listed to indicate the source of requirements specified. Requirement footnotes are as follows:

A = Basin Plan
B = Administrative Procedures Manual

Requirements without footnotes are based on Staff's professional judgment.

A. PROHIBITIONS

1. Discharge to areas other than the disposal facilities shown on Attachment A of this Order is prohibited.

2. Discharge of any wastes including overflow, bypass and runoff from transport, treatment or disposal systems to adjacent drainageways or adjacent properties is prohibited.

3. Discharge of untreated or partially treated wastewater is prohibited.

4. Discharge of wastewater within 100 feet of any well used for domestic supply or irrigation of food crops is prohibited.

B. EFFLUENT LIMITATIONS

1. Effluent flow averaged over each month shall not exceed a monthly average of 1.32 MGD.

2. Effluent discharged to the disposal system shall not exceed the following limitations:

Constituent	Units	Monthly (30-Day) Average	Daily Maximum
Settleable Solids	ml/l	0.1	0.5
BOD, 5-Day	mg/l	60	100
Suspended Solids	mg/l	60	100
Total Nitrogen (as N)	mg/l	7	10
Dissolved Oxygen	Minimum 2 mg/l at any time.[A]		

3. Freeboard shall exceed two feet in lagoons and ponds (unless technical justification is provided to support lesser freeboard).

4. Treatment and discharge shall not cause pollution or nuisance as defined in Section 13050 of the California Water Code.
5. All accumulated biosolids or solid residue shall be disposed in a manner approved by the Executive Officer.

6. Treatment, storage and disposal facilities shall be managed to exclude the public and posted to warn the public of the presence of wastewater.

C. RECEIVING WATER LIMITATIONS
(Ground Water Limitations)

(Receiving water quality is a result of many factors, some unrelated to the discharge. This permit considers these factors and is designed to minimize the influence of the discharge to the receiving water.)

The discharge shall not cause:

1. The following limits to be exceeded in ground water in the vicinity of the discharge:[A]

Constituent	Maximum (mg/l)
Aluminum	1.0
Arsenic	0.05
Barium	1.0
Beryllium	0.15
Boron	1.125
Cadmium	0.01
Chloride	106
Chromium	0.05
Cobalt	0.075
Copper	0.3
Fluoride	1.5
Iron	7.5
Lead	0.05
Lithium	3.75
Manganese	0.3
Mercury	0.002
Molybdenum	0.015
Nickel	0.3
Nitrate (as NO_3)	45
Nitrite	15
Selenium	0.01
Silver	0.05
Sodium	69
Vanadium	0.15
Zinc	3.0
Phenols	0.001
Chlorinated Hydrocarbons	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
Chlorophenoxys	
2,4-D	0.1
2,4.5-TP Silvex	0.01
Synthetics	
Atrazine	0.003
Bentazon	0.018
Benzene	0.001
Carbon Tetrachloride	0.0005
Carbofuran	0.018
Chlordane	0.0001
1,2-Dibromo-3-chloropropane	0.0002
1,4-Dichlorobenzene	0.005
1,1-Dichloroethane	0.005
1,2-Dichloroethane	0.0005
cis-1,2-Dichloroethylene	0.006
trans-1,2-Dichloroethylene	0.01
1,1-Dichloroethylene	0.006
1,2-Dichloropropane	0.005
1,3-Dichloropropene	0.0005
Ethylbenzene	0.680
Ethylene Dibromide	0.00002
Glyphosate	0.7
Heptachlor	0.00001
Heptachlor Epoxide	0.00001
Molinate	0.02
Monochlorobenzene	0.030
Simazine	0.010
1,1,2,2-Tetrachloroethane	0.001
Tetrachloroethylene	0.005
Thiobencarb	0.07
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane	0.032
Trichloroethylene	0.005
Trichlorotrifluromethane	0.15
1,1,2-Trichloro-1,2,2-trifluroethane	1.2

Vinyl Chloride	0.0005
Xylenes	1.750

2. The nitrate-nitrogen (NO_3 as N) level of ground water to exceed 10 mg/l.

3. A significant increase of mineral constituent concentrations in underlying ground water, as determined by comparison of samples collected from wells located upgradient and downgradient of the disposal area.

4. Concentrations of chemicals and radionuclides in ground water to exceed limits set forth in Title 22, Chapter 15, Articles 4 and 5 of the California Code of Regulations.[A]

5. The median concentration of total coliform organisms to equal or exceed 2.2 MPN/100 ml over a seven day period.[A]

6. The pH of underlying groundwater to exceed the range of 6.5 to 8.3.[A]

D. PROVISIONS

1. Discharger shall comply with "Monitoring and Reporting Program No. 97-8" (included as part of this Order), as ordered by the Executive Officer.

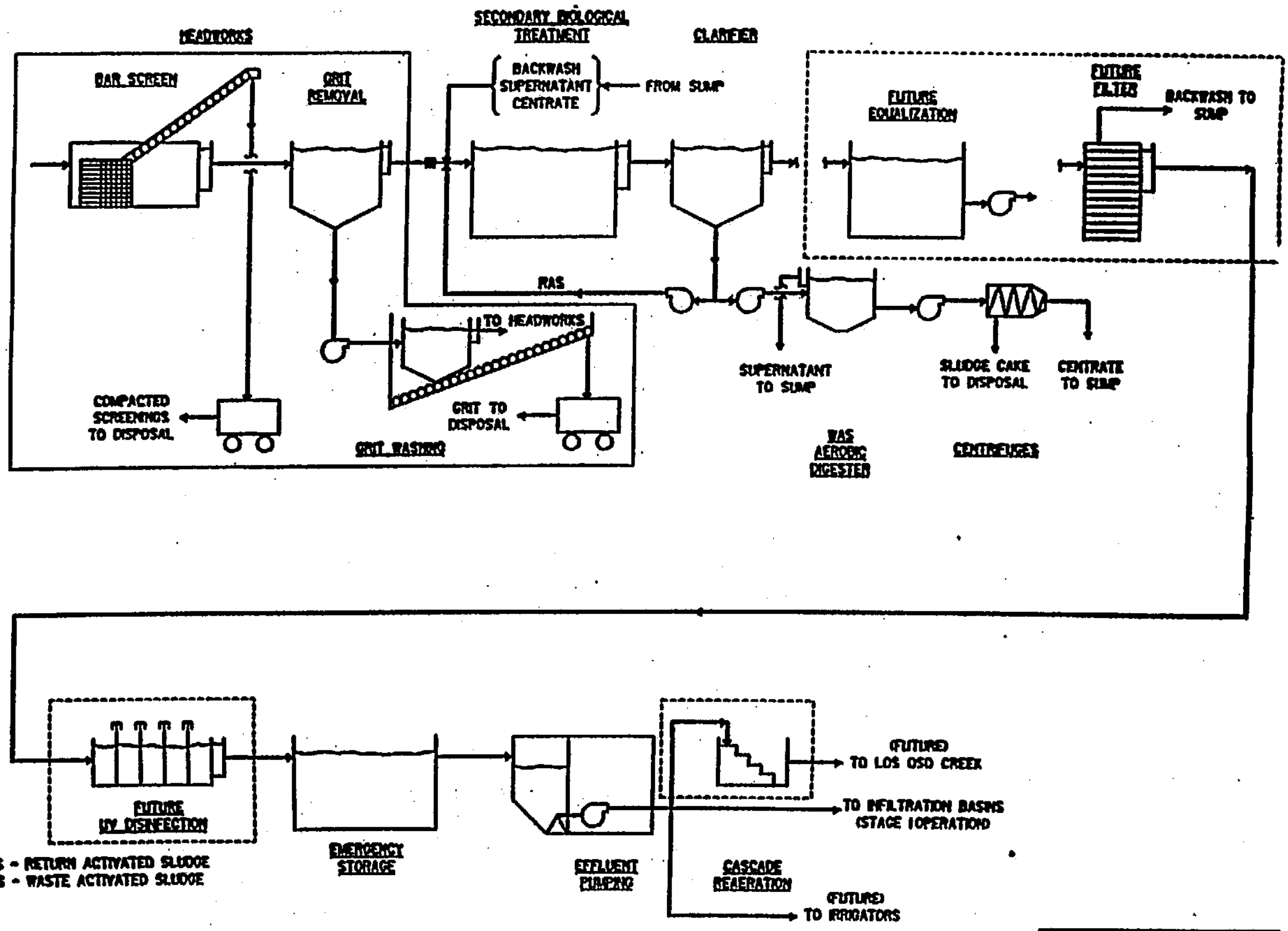
2. Discharger shall comply with all items of the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated January, 1984 (included as part of this Order).

3. Discharger shall develop and implement an on-site wastewater management district to assure ongoing operations, maintenance and monitoring of on-site disposal systems within the unsewered areas in the community of Los Osos and depicted on Attachment A of this Order.

4. Pursuant to Title 23, Division 3, Chapter 9, of the California Code of Regulations, the Discharger must submit a report to the Executive Officer, not later than August 7, 2001, addressing:[B]

   a. Whether there will be changes in the continuity, character, location, or volume of the discharge; and,

   b. Whether, in their opinion, their is any portion of the Order that is incorrect, obsolete, or otherwise in need of revision.



RAS - RETURN ACTIVATED SLUDGE
WAS - WASTE ACTIVATED SLUDGE

LOS OSOS WASTEWATER TREATMENT

FLOW DIAGRAM

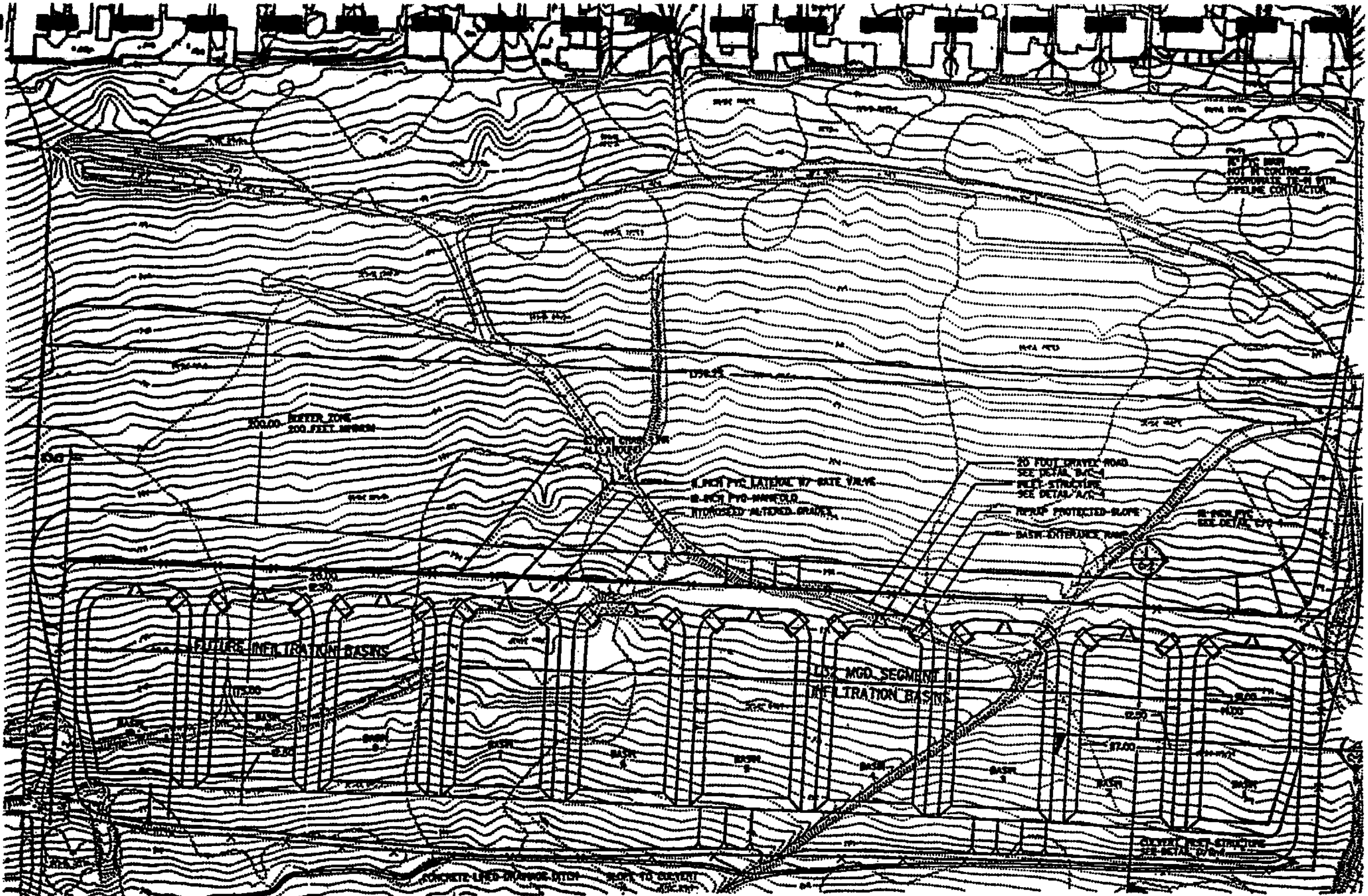


Figure 1-3
30% Design

METCALF & EDDY

HORIZONTAL: 1" = 50'-0"
VERTICAL: 1" = 50'-0"

SAN LUIS OBISPO COUNTY
SERVICE AREA NO. 9
WASTEWATER TREATMENT PLANT
INFILTRATION BASIN FACILITY
SITE PLAN

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COASTAL REGION

MONITORING AND REPORTING PROGRAM NO. 97-8
FOR
SAN LUIS OBISPO COUNTY SERVICES AREA 9
BAYWOOD PARK/LOS OSOS WASTEWATER FACILITY
SAN LUIS OBISPO COUNTY

Influent Monitoring

Representative samples of the influent to the treatment plant shall be collected and analyzed as follows:

Constituent	Units	Type of Sample	Minimum Sampling and Analyzing Frequency
Daily Flow	mgd	--	Daily
Maximum Daily Flow	mgd	--	Monthly
Suspended Solids	mg/l	24-hr. Composite	Monthly
Biochemical Oxygen Demand, 5-day	mg/l	24-hr. Composite	Monthly

Effluent Monitoring

Representative samples of the effluent shall be collected and analyzed as follows:

Constituent	Units	Type of Sample	Minimum Sampling and Analyzing Frequency
Daily Flow	mgd	--	Daily
Dissolved Oxygen	mg/l	Grab	Daily
Suspended Solids	mg/l	24-hr. Composite	Weekly
Biochemical Oxygen Demand, 5-day	mg/l	24-hr. Composite	Weekly
Total Nitrogen (asN)	mg/l	Grab	Monthly

Receiving Water Monitoring (Ground Water)

Representative samples of ground water shall be collected from designated wells and analyzed as follows:

Constituent	Units	Type of Sample	Minimum Sampling and Analyzing Frequency
Total Dissolved Solids	mg/l	Grab	Quarterly (Jan/Apr/Jul/Oct)
pH	Units	Grab	Quarterly
Nitrate (as N)	mg/l	Grab	Quarterly
Nitrite (as N)	mg/l	Grab	Quarterly
Chloride	mg/l	Grab	Quarterly
Sodium	mg/l	Grab	Quarterly
Conductivity	umhos/cm	Grab	Quarterly
Aluminum	mg/l	Grab	Annually
Arsenic	mg/l	Grab	Annually
Barium	mg/l	Grab	Annually
Beryllium	mg/l	Grab	Annually
Boron	mg/l	Grab	Annually
Cadmium	mg/l	Grab	Annually

Chloride	mg/l	Grab	Annually
Chromium	mg/l	Grab	Annually
Cobalt	mg/l	Grab	Annually
Copper	mg/l	Grab	Annually
Fluoride	mg/l	Grab	Annually
Iron	mg/l	Grab	Annually
Lead	mg/l	Grab	Annually
Lithium	mg/l	Grab	Annually
Manganese	mg/l	Grab	Annually
Mercury	mg/l	Grab	Annually
Molybdenum	mg/l	Grab	Annually
Nickel	mg/l	Grab	Annually
Selenium	mg/l	Grab	Annually
Silver	mg/l	Grab	Annually
Sodium	mg/l	Grab	Annually
Vanadium	mg/l	Grab	Annually
Zinc	mg/l	Grab	Annually

Disposal Area Monitoring

The disposal area shall be inspected daily for indications of actual or threatened overflow, seepage, or other problems. An inspection log shall be kept of the disposal area conditions, observations, problems noted, and corrective actions taken. A summary of the log shall be included with each month's monitoring report.

Sludge Monitoring

Representative samples of biosolids removed from the facilities for disposal shall be collected and analyzed as follows:

Constituent	Units	Type of Sample	Minimum Sampling and Analyzing Frequency
Volume	Gallons or Cubic Yards	Grab	Annually or when disposal occurs (whichever is less frequent)
Moisture Content	percent	Grab	" " "
Total metals	mg/l	Grab	" " "

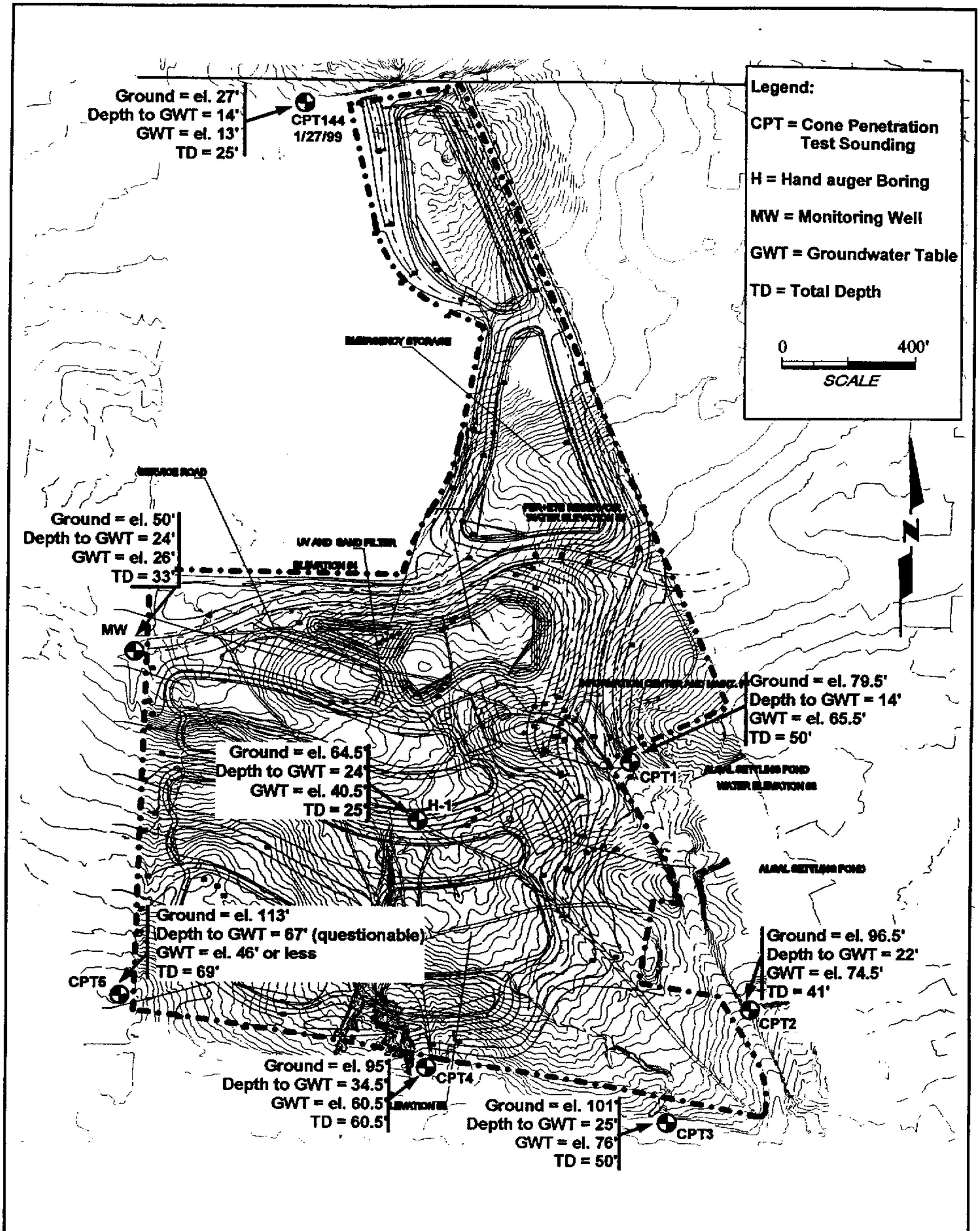
Reporting

Monthly monitoring reports shall be submitted by the 30th day of each month following sampling. Reports shall summarize monitoring data, noncompliance, reasons for noncompliance, corrective action, disposal area monitoring, and any other significant events relating to compliance with Order No 97-8.

ORDERED BY____________________
Executive Officer

April 4, 1997
Date

SJM/P:wdr/lososos.mrp\p:\cm



DRAFT PROJECT REPORT	LOS OSOS COMMUNITY SERVICES DISTRICT LOS OSOS, CALIFORNIA	*OSWALD ENGINEERING ASSOCIATES, INC.* CONCORD, CALIFORNIA	RESOURCE PARK GEOTECHNICAL DRILL AND CPT SITES	SOURCE: CFS GEOTECHNICAL DATE: JAN. 31, 2000	FIGURE 10-1

APPENDIX A
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